HIGH SCHOOL BUILDINGS

VOL. II

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High School Buildings

Compiled by

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FOREWORD

THE popularity of "High School Buildings, Volume I," which is now practically out of print, has encouraged the compiler to present this second collection of illustrations and sketch plans of American secondary schoolhouses.

Even in so short a period as six years, since the earlier book appeared, there have been large changes in American secondary education and these have been reflected accurately in the design and construction of buildings. The high school has entirely outgrown its academic limitations and traditions and has broadened its influence and its curriculum. Thus, the industrial arts and household arts are no longer "basement subjects;" the natural sciences are now taught in a way to require diversified laboratories; the physical care of students has been extended to necessitate very complete gymnasia and lunch rooms; and the movement for the "wider use" of the school plant by adults has become a fixed fact which school authorities have recognized thru better auditorium and night school facilities. The high school building of the present day is far more inclusive and complicated in the number and type of activities which it serves, and the structures illustrated in the following pages bear out this statement.

A departure has been made from the earlier book in the shape of text matter. This consists of articles which appeared originally in the School Board Journal and which aroused considerable attention as statements of fundamental principles in the field of high school architecture.

The hearty thanks of the compiler and publishers are hereby expressed to each of the architects and engineers represented in the book.

W. C. B.

INDEX TO PAPERS

Pages

High School Planning, Dwight Heald Perkins 7
The High School Library, Irene Warren 27
Assembly Halls, James O. Betelle..... 37
Heating and Ventilation of School Buildings, D. D. Kimball................ 47

INDEX TO PLATES

Pages

Andover, Mass., High School.........188-190
Arcadia, Wis., High School...........286-287
Bay Ridge High School, New York, N. Y. 110-112
Belvidere, Ill., High School...........244-246
Bennington, Vt., High School.........278-281
Benson Polytechnic High School, Portland, Ore. 171-174
Binghamton, N. Y., High School......175-178
Bloomfield, N. J., High School........185-188
Boston, Mass., High School of Practical Arts 97- 99
Boys' High School, Louisville, Ky......160-165
Burley, Ida., High School............269-271
Butler, Pa., High School.............193-195
Caldwell, Kans., High School.........314-315
Camden, N. J., High School...........130-133
Central High School, Washington D. C.. 66- 70
Chicago, Ill., Carter Harrison Technical High School 78- 82
Chicago, Ill., Robert Lindblom High School 88- 92
Cleveland High School, Grover, St. Louis, Mo. 83- 87
Columbia, S. C., High School..........153-156
Connellsville, Pa., High School........254-256
Crookston, Minn., High School........288-290
Dayton, Ohio, Stivers High School.....272-274
Dedham, Mass., High School..........316-318
Dunbar High School, Paul L., Washington, D. C. 71- 77
East Aurora, N. Y., High School......275-277
Elko, Nev., High School..............304-307
El Paso, Tex., High School............230-233
Esplanade Avenue High School, New Orleans, La. 134-135
Fairmont, Minn., High School.........222-224
Franklin High School, Benjamin, Portland, Ore. 166-170
Greenfield, O., McClain High School...119-123
Harrison Technical High School, Carter, Chicago, Ill. 78- 82
High School of Practical Arts, Boston, Mass. 97- 99
Houston, Tex., South End Junior High School 296-297
Hot Springs, Ark., High School.......179-181
Huntington, W. Va., High School......124-129
Hutchinson, Kans., Sherman Junior High School 298-300
Iola, Kans., High School 308-310
Ione, Wash., High School.............246-247
Jackson, Cal., Union High School......250-251
Kenilworth, Ill., New Trier Township High School 8- 15
Ladysmith, Wis., High School........237-239
Lake Mills, Wis., High School.........248-250
Lebanon, Pa., High School............147-149
Little Rock, Ark., West Side Junior High School 301-303
Lincoln, Neb., High School............144-146
Lindblom High School, Robert, Chicago, Ill. 88- 92
Logansport, Ind., High School.........191-193
Louisville, Ky., Boys' High School.....160-165
Manasquan, N. J., High School........282-283
McClain High School, Greenfield, Ohio..119-123
Mendota, Ill., High School............225-227
Montclair, N. J., High School.........113-115
Mt. Carmel, Pa., High School.........256-258
New Castle, Pa., High School.........156-159
New Orleans, La., Esplanade Avenue High School 134-135
New Trier Township High School, Kenilworth, Ill. 8- 15
New York, N. Y., Bay Ridge High School 110-112
New York, N. Y., Flushing High School 264-268
Norwood, O., High School.............140-143
Parkersburg, W. Va., High School.....116-118
Philadelphia, Pa., West Philadelphia District High School 100-104
Pittsburgh, Pa., Schenley High School.206-211
Plainfield, N. J., High School.........136-139
Pontiac, Mich., High School........... 17- 19
Portland, Ore., Benjamin Franklin High School 166-170
Portland, Ore., Benson Polytechnic High School 171-174
Redondo Beach, Cal., High School.....204-205
Riverside-Brookfield High School, Riverside, Ill. 220-221
Rochester, N. Y., Junior High School..319-320
Rocky Ford, Colo., Intermediate School.228-229
St. Louis, Mo., Grover Cleveland High School 83- 87
Salt Lake, Utah, High School......... 93- 96
San Juan, Porto Rico, High School.....311-313
Santa Cruz, Cal., High School.........242-243
Schenley High School, Pittsburgh, Pa..206-211
Selma, Ala., High School.............196-197
Shamokin, Pa., High School..........150-152
Sharpsburg, Pa., High School.........284-285
Sidney, O., High School 217-219
Springfield, Ill., High School..........105-109
Sturgis, Mich., High School...........252-253
Trenton, N. J., Junior High School....291-295
Union Polytechnic High School, Venice, Cal. 212-216
Van Wert O., High School............262-263
Venice, Cal., Union Polytechnic High School 212-216
Washington, D. C., Central High School 66- 70
Washington, D. C., Paul L. Dunbar High School 71- 77
Watsonville, Cal., High School........259-261
West Orange, N. J., High School.....198-201
West Philadelphia District High School, Philadelphia, Pa. 100-104
West Springfield, Mass., High School..240-241
Woodland, Cal., High School..........234-236
Ypsilanti, Mich., High School.........182-184

ARCHITECTS

Pages

Adams, Clyde S., Mt. Carmel High School 256-258
Allison & Allison, Redondo Beach High School 204-205
Ashford, Snowden, Paul L. Dunbar High School 71- 77
Bass, Herbert L., Logansport High School 191-193
Bausmith & Drainie, Norwood High School 140-143
Berlinghof & Davis, Lincoln High School 144-146
Christy, E. A., Esplanade Avenue High School 134-135
Cook, Clinton B., Manasquan High School 282-283
Cook, J. Horace, West Philadelphia District High School 100-104
Cooper, Frank Irving, Bennington High School 278-281
Davis, Paul A., Camden High School... 130-133
Dillon, McLellan & Beadel, West Orange High School 198-201
Donovan, J. J., Elko High School...... 304-307
Eckles, W. G., Butler High School..... 193-195
Eckles, W. G., Connellsville High School 254-256
Eckles, W. G., New Castle High School. 156-159
Eldredge & Chesebro, Salt Lake High School 93- 96
Finlayson, A. C., San Juan, Porto Rico, High School 311-313
Fisher, Ripley & Le Boutillier, Anover High School 188-190
Gordon & Madden, Rochester, N. Y., Junior High School 319-320
Harding, Malcom B., West Springfield, Mass., High School................ 240-241
Harris & Merritt, East Aurora, N. Y., High School 275-277
Henry, J. Earl, Louisville Boys' High School 160-165
Hoyt, Clarence P., Amherst High School 202-203
Hussander, Arthur F., Carter Harrison Technical High School 78- 82
Hussander, Arthur F., Robert Lindblom High School 88- 92
Ittner, Wm. B., Central High School... 66- 70
Ittner, Wm. B., Grover Cleveland High School 83- 87
Ittner, Wm. B., McClain High School.. 119-123
Ittner, Wm. B., Springfield, Ill., High School 105-109
Jones, C. Granville, Bloomfield High School 185-188
Keck, Bert D., Crookston High School.. 288-290
Keith & Whitehouse, Ione High School. 246-247
Kilham & Hopkins, Dedham High School 316-318
Law, James R., Lake Mills High School. 248-250
Layton & Smith, South End Junior High School 296-297
Lee, W. H., Shamokin High School.... 150-152
Llewellyn, J. C., Riverside-Brookfield High School 220-221
Mann & Gerow, Sherman Junior High School 298-300

Pages

Miller, Fullenwider & Dowling, Belvidere High School 244-246
Miller, Fullenwider & Dowling, Fairmont High School 222-224
Miller, Fullenwider & Dowling, Mendota High School 225-227
Mountstephen, E. J., Stivers High School 272-274
Mountjoy, French & Frewen, Rocky Ford Intermediate School 228-229
Naramore, F. A., Benjamin Franklin High School 166-170
Naramore, F. A. Benson Polytechnic High School 171-174
Packard, Frank L., Van Wert High School 262-263
Packard, Frank L., Parkersburg High School 116-118
Packard, Frank L., Sidney High School. 217-219
Parker Co., Walter, Jackson Union High School 250-251
Parkinson & Dockendorff, Arcadia High School 286-287
Parkinson & Dockendorff, Ladysmith High School 237-239
Perkins, Fellows & Hamilton, New Trier Township High School........ 8- 15
Perkins, Fellows & Hamilton, Pontiac High School 17- 19
Poland, W. A., Trenton Junior High School 291-295
Richter, A. A., Lebanon High School.. 147-149
Ritter, Verus T., Huntington High School 124-129
Robinson & Campau, Sturgis High School 252-253
Robinson & Campau, Ypsilanti High School 182-184
Russell Co., C. H., Venice Union Polytechnic High School............... 212-216
Sanders, M. B. & Theo., West Side Junior High School, Little Rock..... 301-303
Sanguinet & Staats, Hot Springs High School 179-181
Schweinfurth, J. A., High School of Practical Arts 97- 99
Snyder, C. B. J., Bay Ridge High School 110-112
Snyder, C. B. J., Flushing High School. 264-268
Starrett & Van Vleck, Montclair High School 113-115
Stotz, Edward, Schenley High School.. 206-211
Thayer, C. C. & A. L., Sharpsburg High School 284-285
Trost & Trost, El Paso High School.... 230-233
Urquhart & Johnson, Columbia High School 153-156
Voight, S. S., Caldwell High School.... 314-315
Vosbury, C. E., Binghamton High School 175-178
Warren, W. T., Selma High School..... 196-197
Weeks, W. H., Santa Cruz High School. 242-243
Weeks, W. H., Watsonville High School 259-261
Weeks, W. H., Woodland High School.. 234-236
Wilder & White, Plainfield High School. 136-139
Williamson & Co., Thomas W., Topeka High School 308-310
Wilson, C. L., Burley High School..... 269-271

HIGH SCHOOL PLANNING

DWIGHT HEALD PERKINS

Illustrated by four examples from the work of Perkins, Fellows & Hamilton, Architects, Chicago

It is a curious fact that a term so generally used as "High School" does not convey an idea of a secondary school having more or less standardized elements. The fact is, however, that no common interpretation of the term "high school" exists. This is because of the recent and rapid development of the high school idea, and of the various conditions under which high schools are planned and built, as well as the changing and far-from-uniform ideas governing their conduct.

Inasmuch as there is no unanimity, we will assume a definition of a high school, which whether it conforms to the convictions of the reader or not, will at least serve to explain the buildings used for illustrations in this article.

The fact that scarcely any two high school principals would agree at first on the definition of a high school and a statement of its requirements, and that very few principals have the same methods of estimating the capacity of a high school, makes the problem of the school architect both baffling and interesting. He must not only meet the desires and requirements of the board of education for whom he works, but he must understand the principles of the organization and conduct of a high school so that he may plan his building in accordance with general requirements. It is necessary that he build so that succeeding administrations may use his building in later years with the minimum of change or no change other than enlargement.

The rapid development of the junior high school idea, including vocational work in the seventh and eighth grades, or the "six-and-six" plan as opposed to the former "eight-and-four" plan, presents still another changing element, which must be met in the arrangement of modern high schools. Likewise the increasing use of auditoriums, gymnasiums, shops, and other portions of the school plant by the public, is something that must be provided for.

Not a long time ago a high school might be considered complete without study halls, provided there was a seat in a classroom for each pupil, and also provided that there was some kind of an assembly hall. Today this is not the case; some boards and principals demand a seat in a study hall for every pupil in the school; others, for half the number of pupils; and still others are introducing the directed study plan by which study space and recitation space are combined in classroom units, leaving separate undirected study rooms for senior and junior years only. To all of these controlling elements, must be added consideration of school population, which is rarely if ever stationary. The fact that population increases and that additions must be made in the future; that limitations of a financial character always exist, as well as the character and size of the high school site must likewise be considered. The conditions of site obviously control the general shape of the building and it is generally agreed now that a high school for a thousand pupils should contain at least ten acres, and that fifteen acres is better.

Definition of a High School.

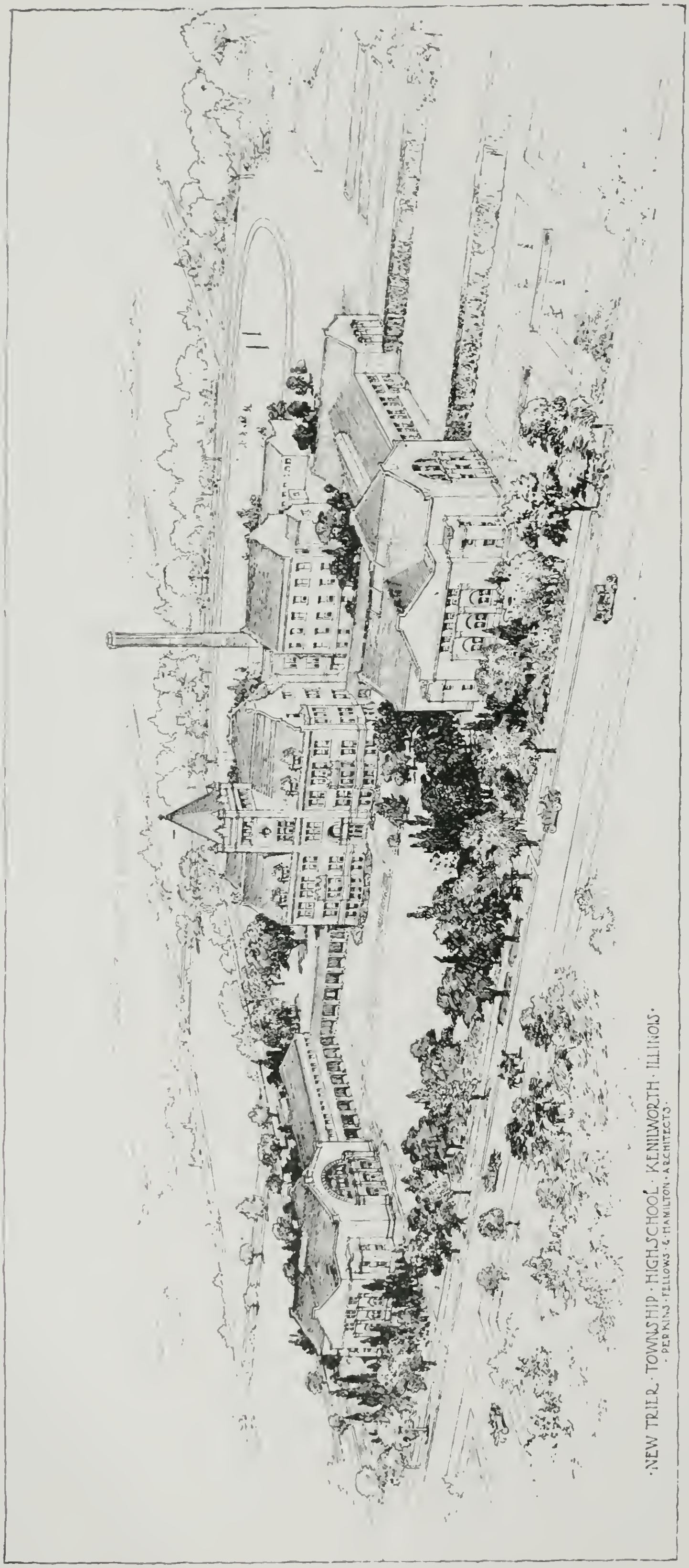
From our observation and from conference with many school people, we deduce the following, as a working definition of a high school to accommodate a thousand or twelve hundred pupils:

Classrooms. In the academic department there shall be sufficient classrooms for mathematics, languages and history; in the scientific department, there shall be laboratories, lecture rooms, and store rooms, for physiography, physics, chemistry, botany, zoology, and perhaps horticulture or agriculture.

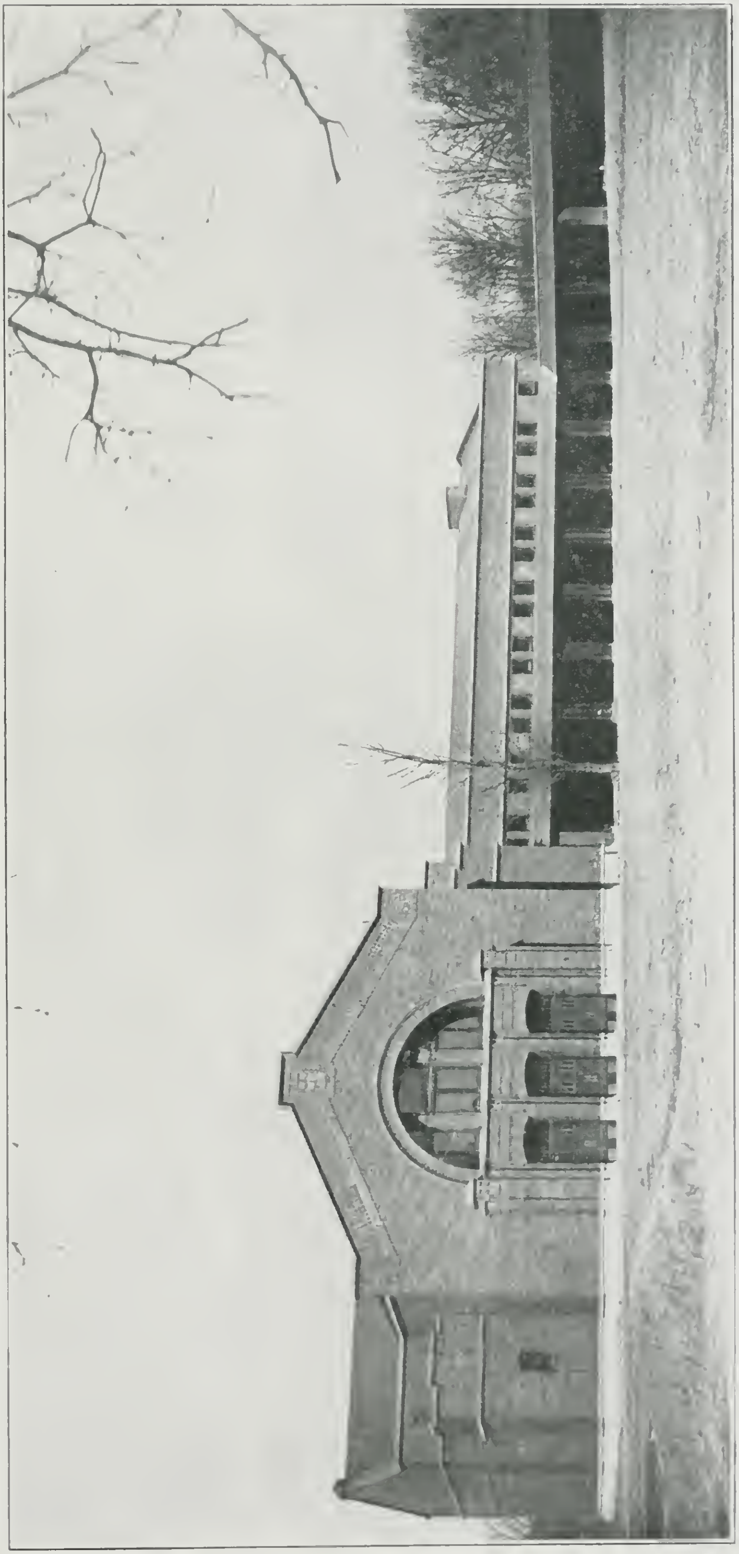
Manual Training. There shall be in the vocational department, shops for wood bench work, wood turning, wood patternmaking, for foundry, for forge, for machine shop, and possibly for electrical construction. There shall also be a printing shop.

For the girls, rooms for cooking, for laundry work, for sewing, and for practice in the care and maintenance of the home.

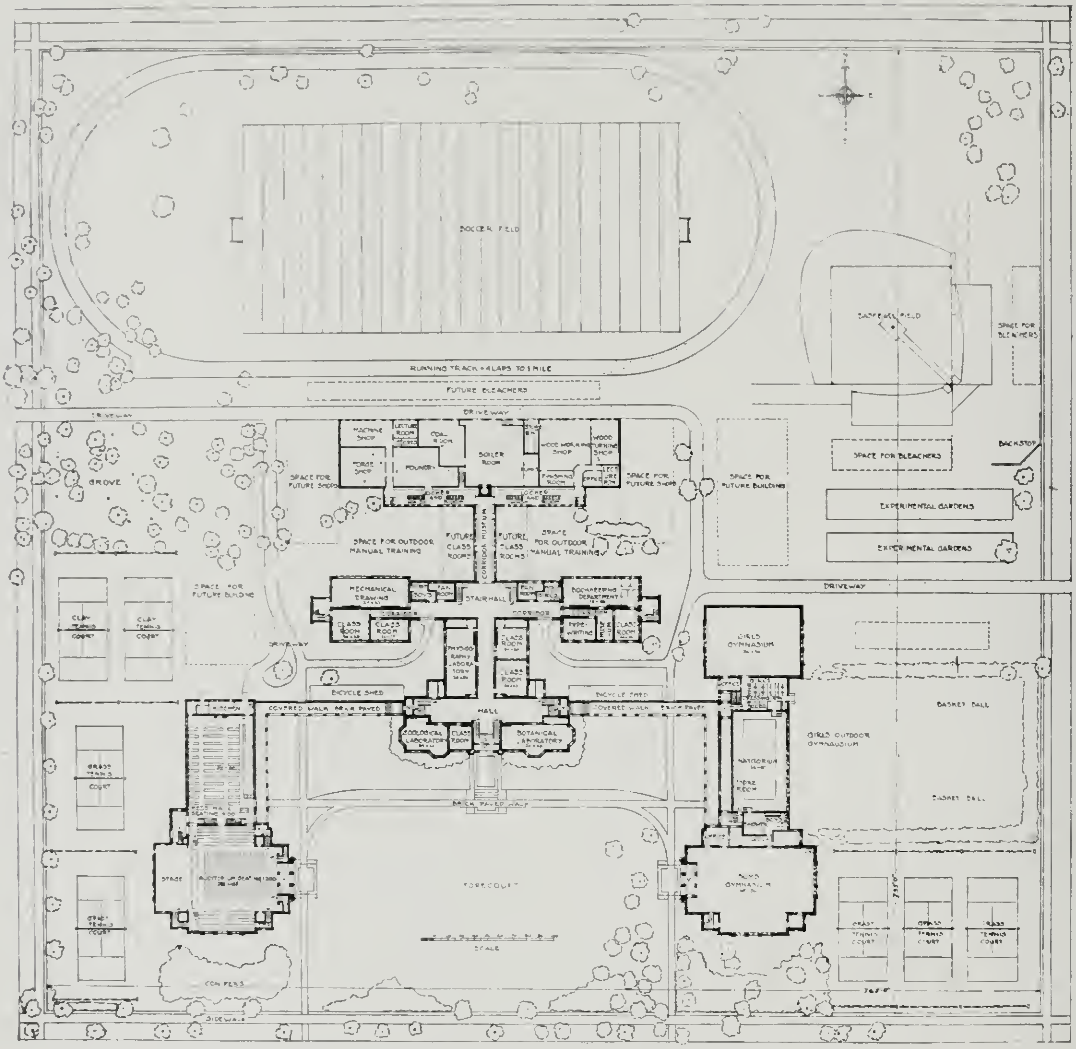
Drawing. In the drawing and art department, there shall be rooms and equipment for mechanical drawing, for free-hand drawing, for applied design; for art work in metals and clay. There shall also be studios and laboratories for



NEW TRIER TOWNSHIP HIGH SCHOOL, KENILWORTH, ILL.



AUDITORIUM AND CAFETERIA WING, NEW TRIER TOWNSHIP HIGH SCHOOL.



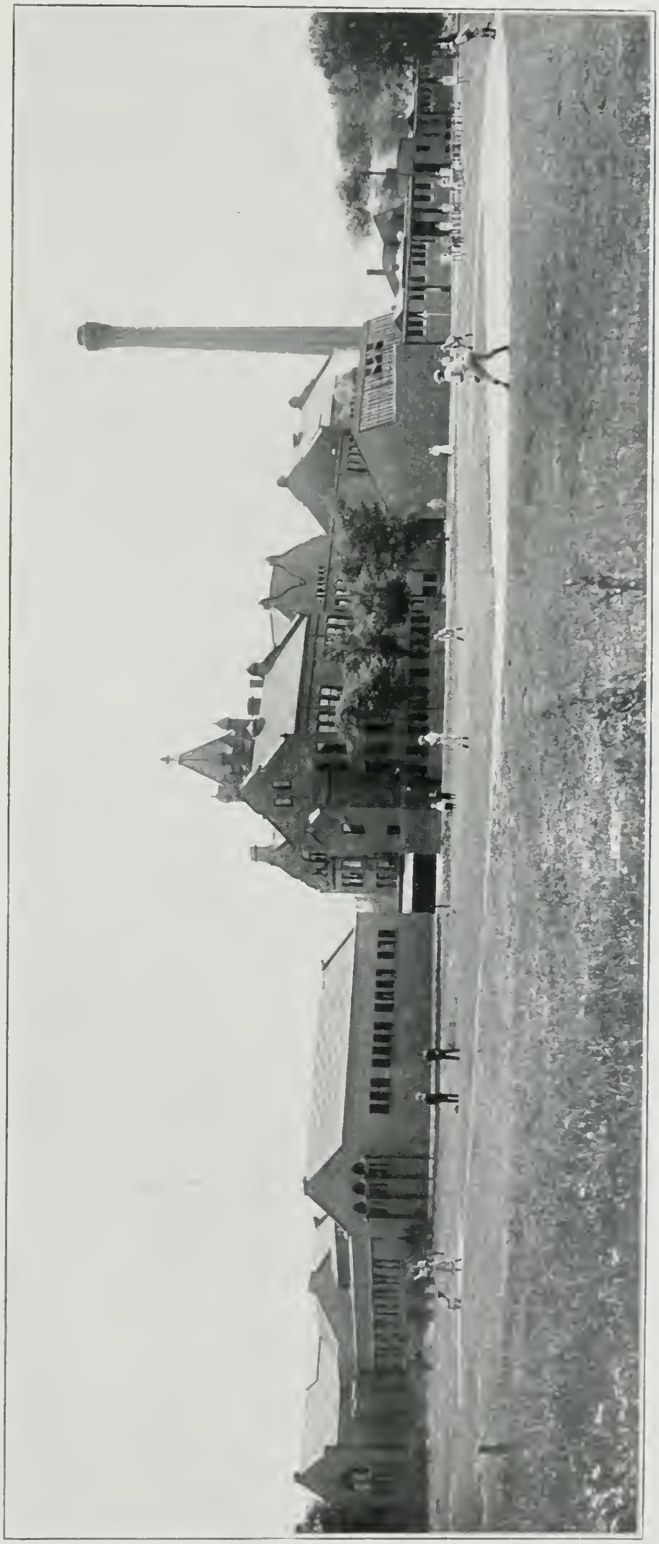
PLAT OF NEW TRIER TOWNSHIP HIGH SCHOOL, KENILWORTH, ILL.

applied or commercial design, to be used in conjunction with the shops and sewing rooms.

Commerce. In the commercial branch of vocational work, there shall be rooms for typewriting; for stenography; for bookkeeping, banking; correspondence; penmanship and commercial geography.

Assembly Halls. All high schools for a number of years have included an assembly hall, and it is now commonly demanded that the assembly hall be large enough to seat the entire school, and that it be so arranged that it may be used by the public not only in the evening, but during the daytime hours without interfering with school sessions. School boards have come to demand a special type of stage in these assembly halls; one, which may seat approximately two hundred people in a high school of a thousand, and which may be adapted both for dramatics with a small proscenium opening, or for choral work with a large opening. Stages in modern assembly halls are now being adapted for and used by the music departments, so that choruses or orchestras may use them for their daily work, and that they may at such times be separated from the assembly hall; simplifying the problem of administration and heating.

Library. High schools always demand reference libraries; sometimes they are required in one location only; sometimes separated into



PHYSICAL CULTURE GROUP, MAIN BUILDING, SHOP AND ATHLETIC FIELD, NEW TRIER TOWNSHIP HIGH SCHOOL, KENILWORTH, ILL.

scientific and classical departments, variously located according to use. Again it is frequently required that the facilities of a circulating library be instituted, in which case, easy public access is a necessity. All of these elements are included in our definition.

Lunch Room. The modern high school requires a lunch room capable of seating at least half of the ultimate pupil capacity, as well as a kitchen and store room large enough and well enough equipped to manufacture and cook and serve foods, and store supplies in wholesale quantities.

Gymnasiums. All high schools now require a gymnasium large enough for basket ball and indoor base ball. A change is rapidly coming; in fact may be said to be here, by which the athletic exhibition idea is recognized and provided for. Running tracks are being eliminated in favor of the outdoor field track; and spectators' galleries and seats are taking the place of the former running track inside the gymnasium. It is not an uncommon requirement that a gymnasium shall accommodate at least five hundred spectators. A high school is not regarded complete now unless it has a separate gymnasium for girls, and a natatorium for alternate use of the boys and girls, and some high schools are now requiring what is termed an exercise room for physical drill, in addition to the two gymnasiums. This is more for individual development and preparation than for team athletics, which are coming to monopolize the gymnasium.

Athletic Field. There is practical unanimity now upon the demand that the field and the school be in the same location—a field one-half mile or more away is only accepted as a last alternative. This is particularly true where the Gary idea is being introduced, which involves the use of all portions of the building and accessories at all times. This program not only increases the capacity of the school building and field, but makes it the custom that the field shall be used in the morning as well as the afternoon and necessitates very close proximity and availability.

Accessories. It is unnecessary to mention the accessories which are required by all schools in addition to the above, such as fireproof construction, corridors and stairs; ample exits; locker rooms and toilets; book and supply store; heating and lighting apparatus; administrative offices; vaults, etc. The greatest divergence in any of these items relates to the lockers; some recognized authorities prefer the separate locker room, but an increasing number appear to prefer the corridor locker, if it can be made of metal; be securely locked, and be thoroly ventilated by a constant flow of air in at the bottom and out at the top.

Classrooms are uniformly required which have unilateral light and at least fifteen feet of floor space per pupil; a majority of authorities will prefer east and west light for all classrooms except those used for drawing. South light is preferred for most laboratory work, and north light for drawing, for shops and certain other vocational work.

Pupil Capacity of High School Buildings.

It is coming to be commonly accepted that classrooms are to be limited in their capacity to thirty pupils. All of this may be regarded as a statement of the requirements of the modern high school, and may be accepted as a definition so far as this article is concerned.

It brings us to the next point of consideration, which is that of capacity. The School Board Journal is exerting its influence toward a clear and generally understood statement, or method of determining the capacity of schools. Our own method, which is frankly an approximation of the methods and ideas of a number of educators is, to assume—

First, that a high school has all of the elements described above, and that its capacity may be assumed to be the number of seats in the classrooms (number of classrooms multiplied by thirty) plus fifty per cent of that number. This fifty per cent is assumed to be the number of pupils in the shops, gymnasium, laboratories and drawing rooms.

This method will be used in estimating the capacity of the schools used for illustrations in this article.

In this connection a discussion of the number of stations per pupil is pertinent. A school can be arranged meeting this definition and this estimate of capacity with three stations per pupil; that is, there may be a seat in the assembly hall for each pupil; there may be a seat in a classroom for three-fourths of the pupils; there may be seats in study halls for three-fourths of the pupils at one time, and there may be space in some laboratory, shop or drawing room for half of all of the school at one time. This would make a three-station school, and would permit of the degree of flexibility usually required in organizing and conducting a high

school. There are authorities, however, who believe that there should be a seat in a classroom and a seat in a study hall, for the entire school, or for every pupil at one time. These proportions, if carried out, show four stations for every pupil, and obviously make the problem of organization much easier. It also gives a home room to every teacher as well as a home desk in a study hall to every pupil. The Illinois school which is one of the four illustrated in this article, is the only one of the four schools here shown, in which this "four station" idea is worked out.

Cubic Foot Cost.

It is not the purpose of this article, which is a discussion of new elements in planning, to refer at any great length to the item of cost. This could not be done in any careful or valuable manner under building conditions, existing in 1917. The method most generally used and the one producing the least confusion, is the cost per cubic foot method. This, however, is misleading, unless it accompanies a definition of a high school which will make clear, what it is that is being provided for each pupil; or in other words, will state the number of cubic feet built for each pupil, or again the number of dollars required to build a high school, per pupil.

This latter test would be the more valuable one, if there were unanimity upon the definition of what should be included in a high school built and equipped for a complete course. The original portion of the Pontiac High School built in 1913, illustrated herewith, was built at the rate of fourteen cents per cubic foot, fireproof construction. This building did not comply, however, with the definition which we are following, and there is at the present time an addition equal to fifty per cent of the original building being constructed. These contracts were let in 1917 and the cost due to present conditions, for construction similar to that of 1913, was twenty cents per cubic foot. Authorities differ in their statements of cost per pupil all the way from \$300 to \$500. It is the opinion of the writer that \$400 per pupil ought to be appropriated at a time when building can be done for fifteen cents per cubic foot, in order

NATATORIUM, NEW TRIER TOWNSHIP HIGH SCHOOL, KENILWORTH, ILL.

ASSEMBLY HALL, NEW TRIER TOWNSHIP HIGH SCHOOL, KENILWORTH, ILL.

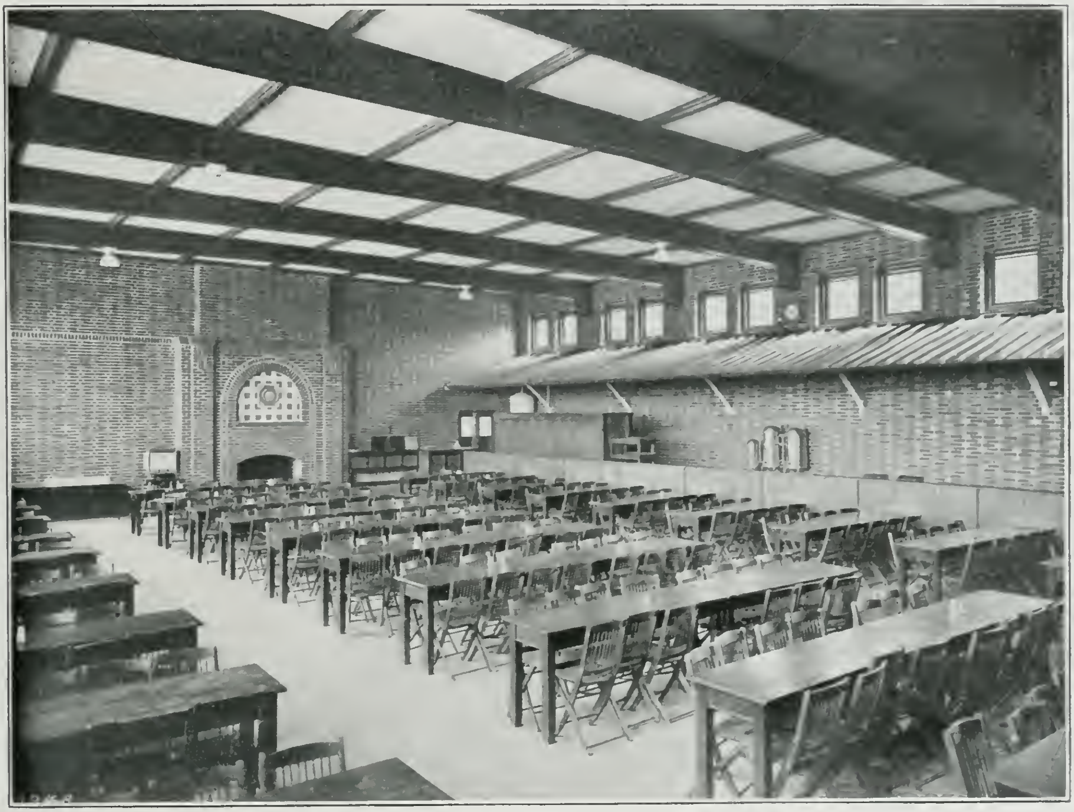
that a complete high school may be constructed and at least one thousand pupils provided for. This ratio will decrease slightly as the number of pupils to be accommodated increases.

It is hoped that the efforts now being made by various committees to define and unite upon a system of measurements, may bear fruit; but in order that it may be of the greatest usefulness, such measurements must be related to some equally well understood and accepted definition or statement of requirements of a modern high school. Having determined upon the definition; having acquired the site; and having knowledge of the funds available, the next step in the planning of a high school, is the consideration of type plans and the choice of the general scheme of arrangement.

Types of Plans.

We may to a degree ignore cost in the choice of a type of plan, because the differences in cost between the various types are not great enough to counterbalance the advantages of the most desirable arrangement. Boards should insist upon the provision that the plan be so devised that future additions may be made readily without the loss of school time or public money. Wherever the site contains ten acres or more, perfect freedom of choice in the type of plan will exist. We shall discuss later a solution where such a choice did not exist because of the small dimensions of the site. Having chosen a type which may be built if necessary on the installment plan, the wisest course is to go as far as the funds permit with the best plan and then stop. It is never wise, no matter how limited the funds may be, to build anything which is not planned exactly as desired. A proper plan partially built, may be completed later; an improper plan can only with difficulty, if at all, be converted into a proper one, at a future date.

The types of plan for comparison and choice may be indicated by such general terms as these: The "Hollow Square Plan"; the "T" plan; "E"



LUNCHROOM, NEW TRIER TOWNSHIP HIGH SCHOOL, KENILWORTH, ILL.

plan; "H" plan; the "Group Plan" and the "Group Plan Concentrated."

Hollow Square Plan. The "hollow square plan" has probably been adopted in more cases in the United States than any other general type. It has a center entrance leading directly to the assembly hall, which is in the center of a large court, around which corridors circulate, with educational space on one or both sides.

"E," "H" and "T" Plan. The "E" and "H" plan are in general, composed along lines suggested by the shape of these letters. The same is true of the "T" plan, which has the element of concentrated corridors, and easy control, which none of the others possess to so great a degree. All of these plans may develop into buildings that are well lighted if the hollow square is large enough to make the center court ample.

Group Plan. The "group plan" proceeds generally on the assumption that it is wise to concentrate the academic and scientific portions in a central and higher building than the other portions, and that it is advisable to have such large units as the assembly hall, gymnasium, mess hall and natatorium directly upon the ground level, without basements beneath or stories above. The advantages are greater safety, due to the absence of stairs; greater light due to the possibility of sky-lights; and easier adaptability for concurrent use by the public, or by portions of the school, such as orchestras and choruses, which might disturb school sessions if they were closely related to the classroom portions.

This plan also makes a more practical, better lighted and better ventilated shop arrangement for the manual training department, than any plan in which these rooms are incorporated with others in one main building.

Group Plan Concentrated. The "group plan concentrated," which appears to be a contradiction in terms, is one in which the advantages and elements of the group plan spread over a wide area, are so brought together or concen-

trated, that the structure may be erected upon a comparatively small site.

It has been found by experience that the group plan does not vary greatly in cost over the large single building, which must be generally three stories high, sometimes more. The extra expense which is occasioned by the greater amount of foundation construction and the greater area of roofs and sky-lights, is offset by the saving in stairways, in thickness of walls; in the omission of basements, and the consequent expensive floor construction between basement and main floors, and the cheaper method of constructing roofs, which in the group instance, may be less expensive and less fireproof than is the case wherever people are housed in rooms built over large areas with great spans.

The fact of the possibility of skylights and the consequent perfect light which their use provides, is so great an advantage as to justify considerable extra expense, even if that be necessary; and of course it is unnecessary to state that the advantage in the item of safety of the people when they are on the ground level, is worth any reasonable amount that it may cost to provide such safety.

Reference to the accompanying illustrations will also show the very easy manner in which future additions or extensions may be arranged. It is possible to exclude an entire division, like the physical culture portion consisting of the two gymnasiums and the natatorium, if funds are limited, and the rest of the plan can be put up in proper manner, even tho these portions are postponed. This is exactly what happened in the New Trier instance; the physical culture portions were not put under contract until several months after the other portions were contracted for, and not until a referendum vote had been submitted to the people, which resulted in their emphatic endorsement of and demand for these portions of the school.

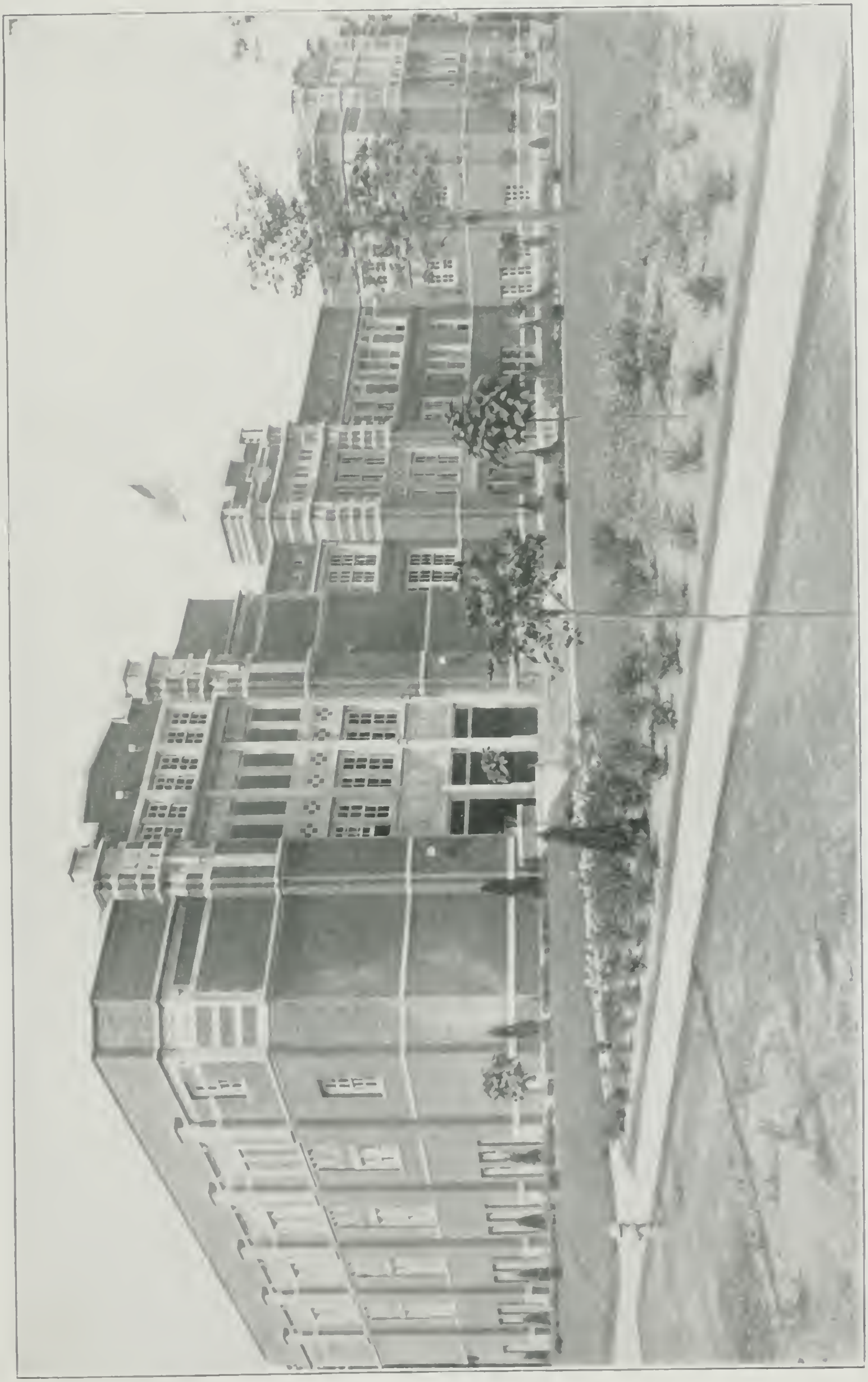
Another advantage in the Group Idea is that it enables those large units—assembly hall, mess hall, gymnasiums—to be built according to dimensions large enough for the ultimate school capacity. It is obvious that such units cannot be increased after they are once built. On the other hand, classrooms and laboratories not needed at the time the structure is originally erected, may be easily postponed. Such units as these may be multiplied as needed and as the school population grows and need not be built until they are needed. This again is an obvious financial advantage.

Still another feature of the group plan, and one which is illustrated at the New Trier school, is the freedom to meet changing educational demands. There are two large units planned in the New Trier group without any reference to what their use will be. The space is there; buildings erected thereon may be devoted to most any conceivable educational requirement, and they may be connected with the heating, ventilating and lighting plant, as well as the corridors whenever in the future such educational demand is developed sufficiently to enable these requirements to be known.

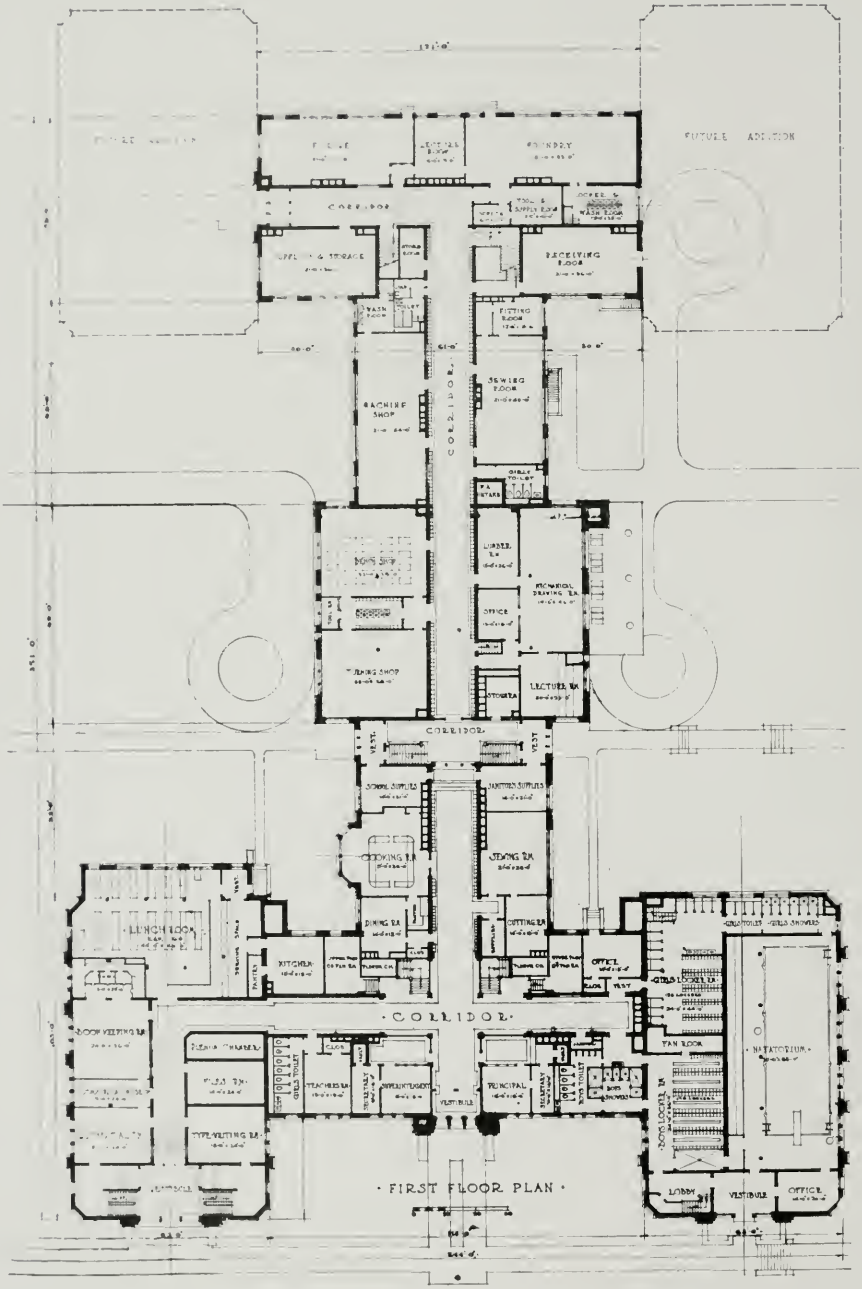
The Illustrations.

The illustrations accompanying this article, illustrate: First, The group plan for a fourteen acre site, as was built for the New Trier Township High School at Kenilworth, Ill. Second, the "T" plan adapted to a site which was only three hundred feet wide. The building was erected at Pontiac, Mich. This site is of indefinite and ample length and the additions are therefore being constructed along the main central axis. Third, a plan which has been adopted by an Illinois Township High School Board of Education for construction for a school of from twelve hundred to fifteen hundred students. This is the "T" plan with large units at either end, which may be connected or separated in their use from the central main portion. Fourth, a plan which has been adopted by a Michigan board of education, which illustrates for lack of a better or more logical term, what we call, the "concentrated group." This gives as far as possible, the advantages of both the New Trier open block plan and the "T" plans in both the Pontiac and the Illinois school, under conditions of a very contracted site, about three acres. It is of course obvious that there is no athletic field in the fourth plan, but with that exception, the elements and facilities in our definition are all included in this instance.

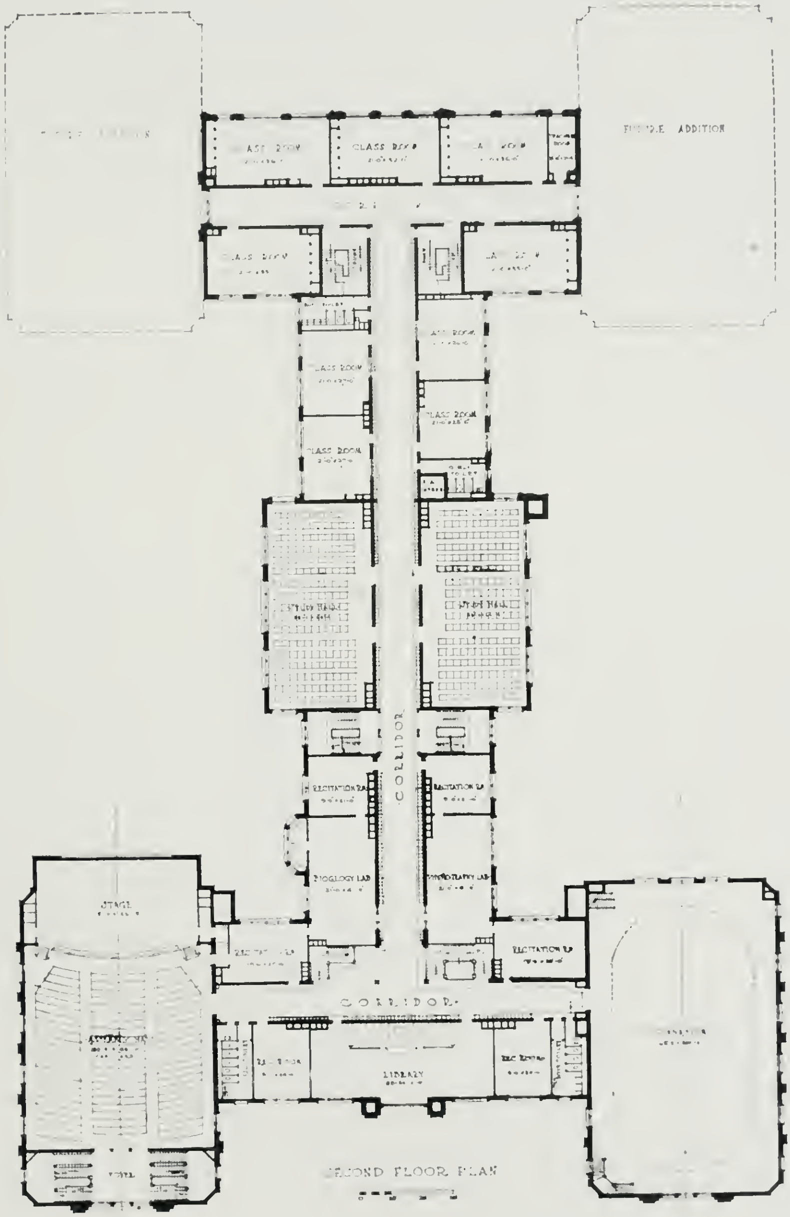
First Illustration—the New Trier High School. In this instance the main frontage is south. The original building which is the central portion around the tower, was designed several years ago by Patton & Miller, architects. The re-arrangement of the center portion and the construction of the surrounding units which is the work of Perkins, Fellows & Hamilton, was erected in 1911. All of the desirable elements noted above in the description of the Group Plan will be found upon examination of the drawings, to exist in the New Trier School.



HIGH SCHOOL, PONTIAC, MICH. Perkins, Fellows & Hamilton, Architects, Chicago.



FIRST FLOOR PLAN, HIGH SCHOOL, PONTIAC, MICH.



SECOND FLOOR PLAN, HIGH SCHOOL, PONTIAC, MICH.

In addition to this, a quarter mile running track; a foot ball gridiron; a base ball diamond, and seven tennis courts are provided for. The girls have special consideration in the field, a track over an acre in extent being devoted exclusively to their use, and separated from the rest of the field by a high hedge.

The corridors connecting the main buildings with the outlying units are roofed but not enclosed, it being the desire of the management that the children should have as much exposure to outdoor air as that implies in passing from one part of the plant to the other between periods. The capacity at present is seven hundred pupils; ultimate capacity will be twelve hundred.

Second Illustration—the Pontiac, Michigan, High School. The superintendent in this instance desired local and central control of the corridors and the "T" plan was adopted. The usual assembly hall with the gymnasium either beneath or above, located opposite the main center entrance was avoided, because one or the other is almost always poorly lighted. A main corridor on the central axis was also desired for access to future extensions. A separate unit to the left, or south, in which the assembly hall was located, was built; and a similar wing to the north in which the gymnasium and natatorium were located, was also built. The study halls were placed on opposite sides of the main long corridor, and this corridor is now being extended beyond the study halls to unite the addition at present under construction.

It will be seen that the assembly hall and gymnasium wings, each of which has separate entrances for the public, may be separated entirely from the school, and used by the public, particularly in the evening, or they may be entered directly by the pupils of the school thru the main corridors in the daytime. The former capacity was 675; the present capacity is one thousand pupils.

Third Illustration—an "Illinois High School." In this case the management desire corridor control, and have therefore adopted the "T" plan for the academic and scientific portions. All of the elements referred to as desirable in both the New Trier and the Pontiac plants, have been retained insofar as they apply to the assembly hall, gymnasiums and natatorium. Because of a peculiar grade in the site, a high basement exists, and it has therefore seemed advisable to build the boiler rooms and power department, as well as the shops within the west wing, placed at right angles to the main axis.

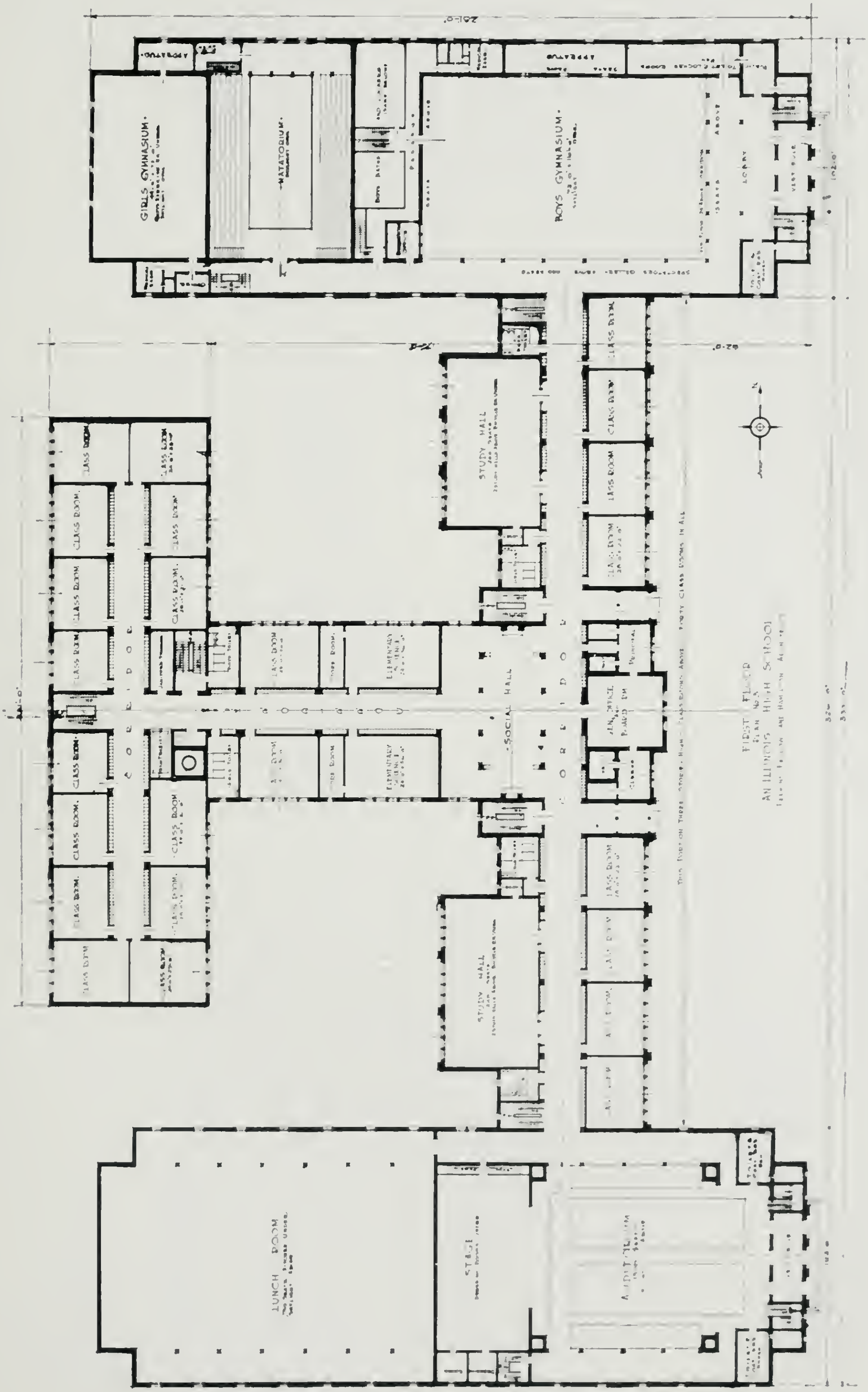
The plan is interesting, because it embodies the four station per pupil idea. The capacity is twelve hundred pupils; as many schools are conducted the capacity will be fifteen hundred pupils.

Fourth Illustration — a "Michigan High School." As stated above this plan includes all of the top light advantages of the New Trier and Illinois schools. The units may also be built at various times, postponing portions if necessary in order to spread the expense over a greater period.

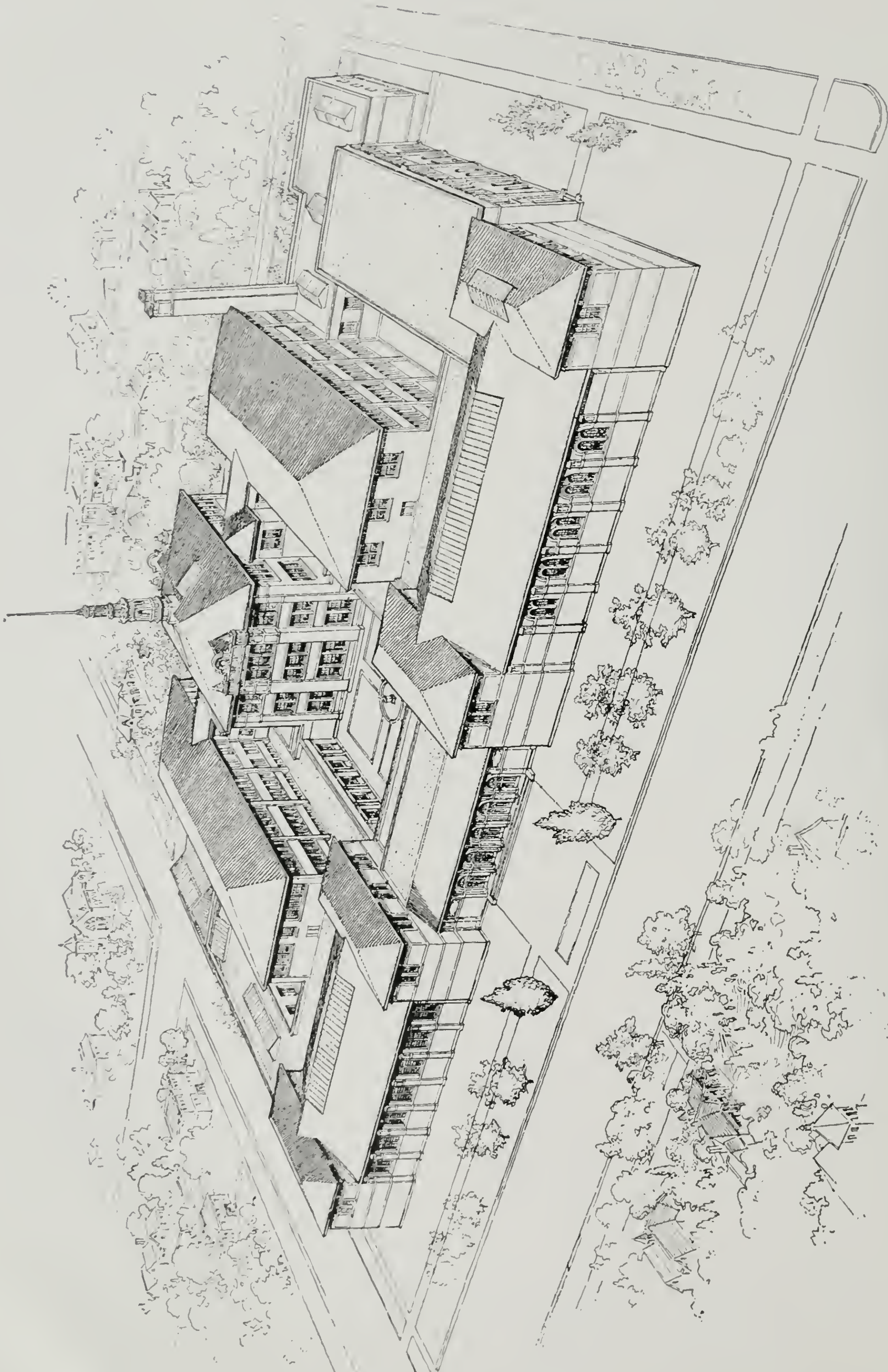
The item of control in this case differs radically from that in the Illinois school—in that plan the control is in the hands of the principal and his assistants in the office, located between the two main entrances, the principal being less desirous of controlling the public than he is of controlling the pupils. While the principal in the school illustrated in the fourth plan does not give up his control of the pupils, his clerks at the counter have absolute control of both pupils and the public as they enter the center foyer, from which they proceed directly, on the one hand to the auditorium, and on the other hand, to the gymnasium, and by proceeding directly to the north, the pupils enter the locker rooms, corridors and stairways.

The study halls illustrated in the fourth plan are frankly removed from the principal's office, and are under the control of separate teachers or monitors and are related closely to the classrooms, laboratories, the commercial and art departments, as well as the shops on the first floor.

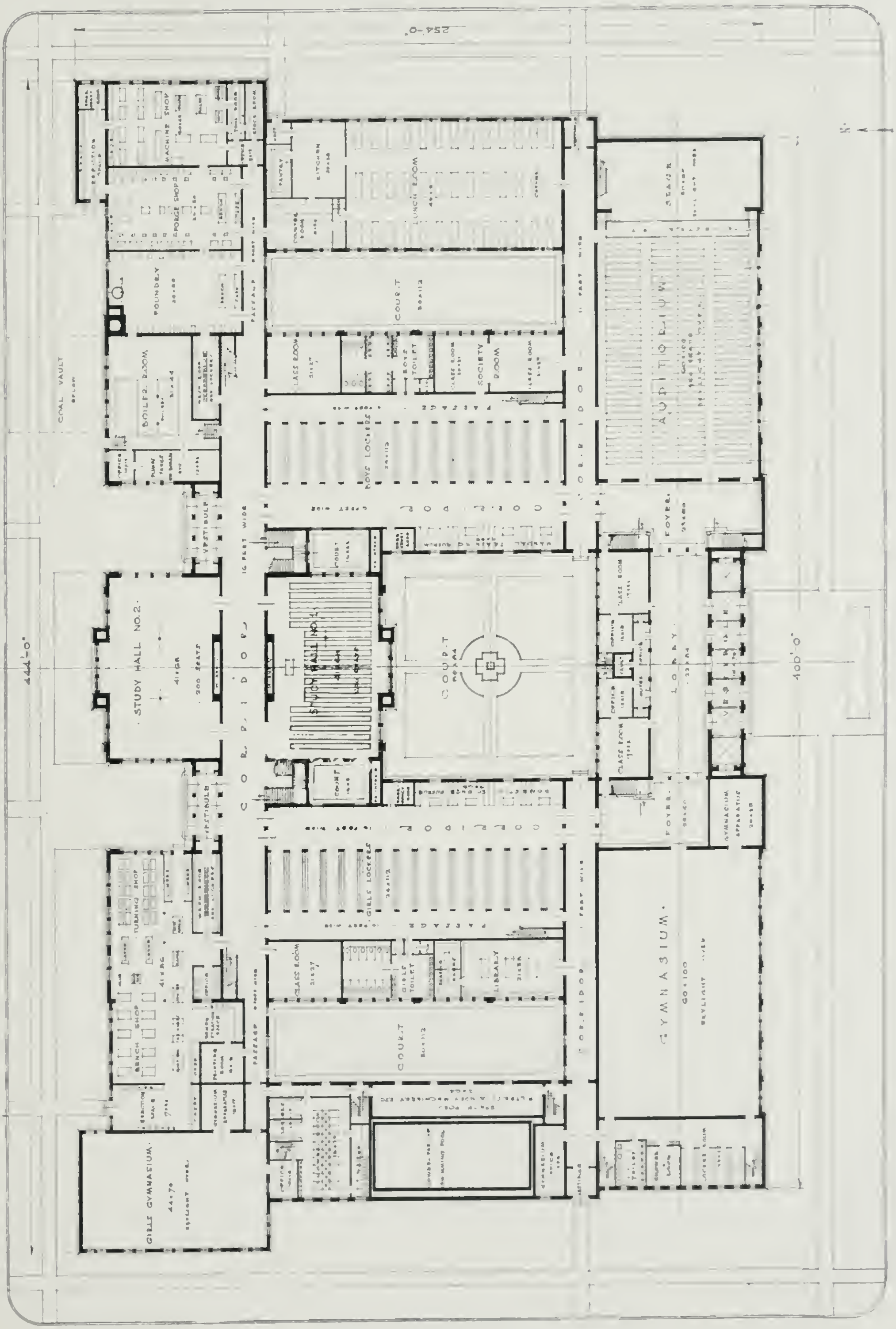
This plan is on the basis of a seat in the study hall for each pupil, and has not yet been related to the coming idea for directed study. This plan if incorporated in the organization of the school will make some changes in this portion of the structure. This fourth plan is on the basis of three and one-half stations per pupil, and is rated according to our method, as a twelve hundred pupil capacity high school.



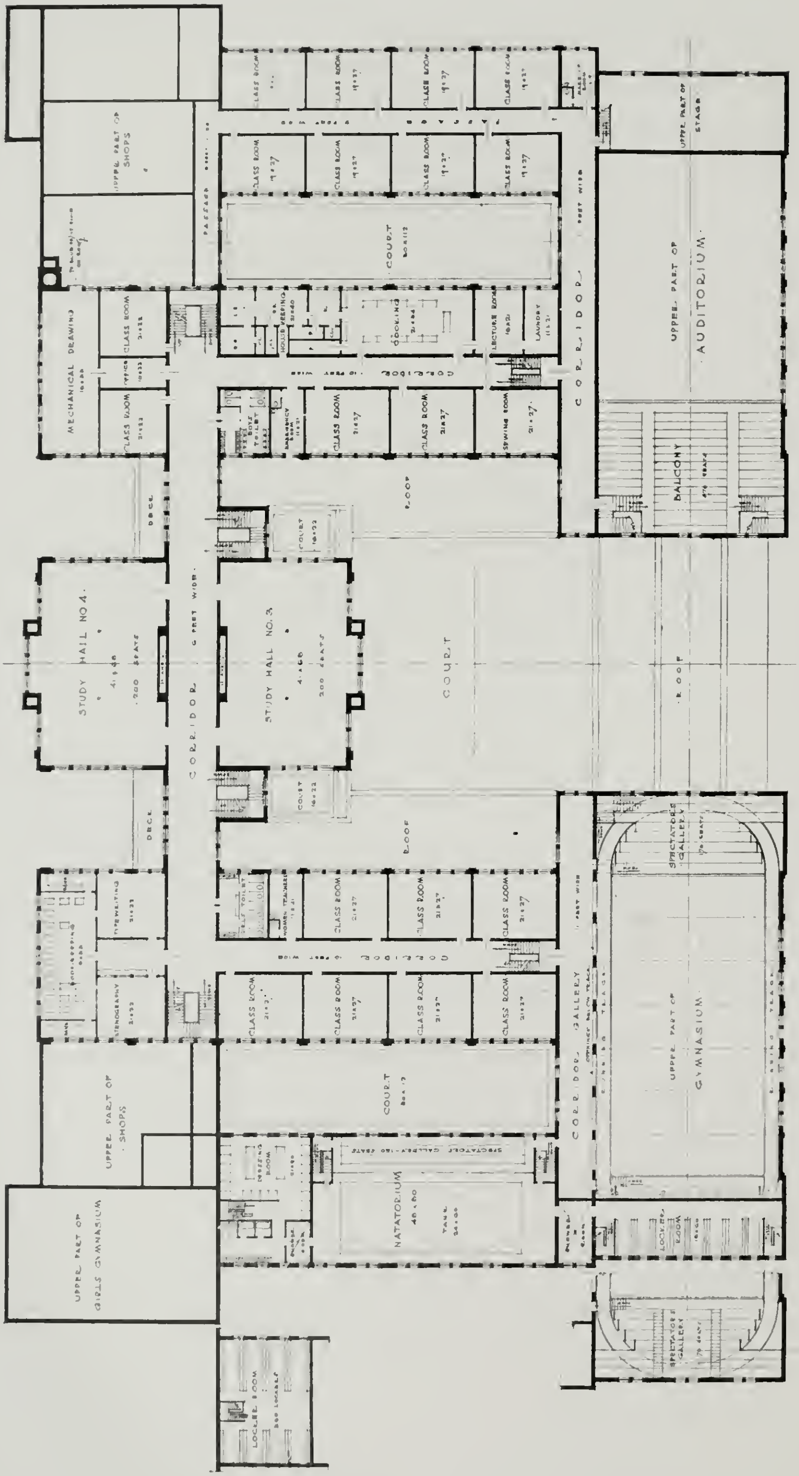
FIRST FLOOR PLAN, AN ILLINOIS HIGH SCHOOL.



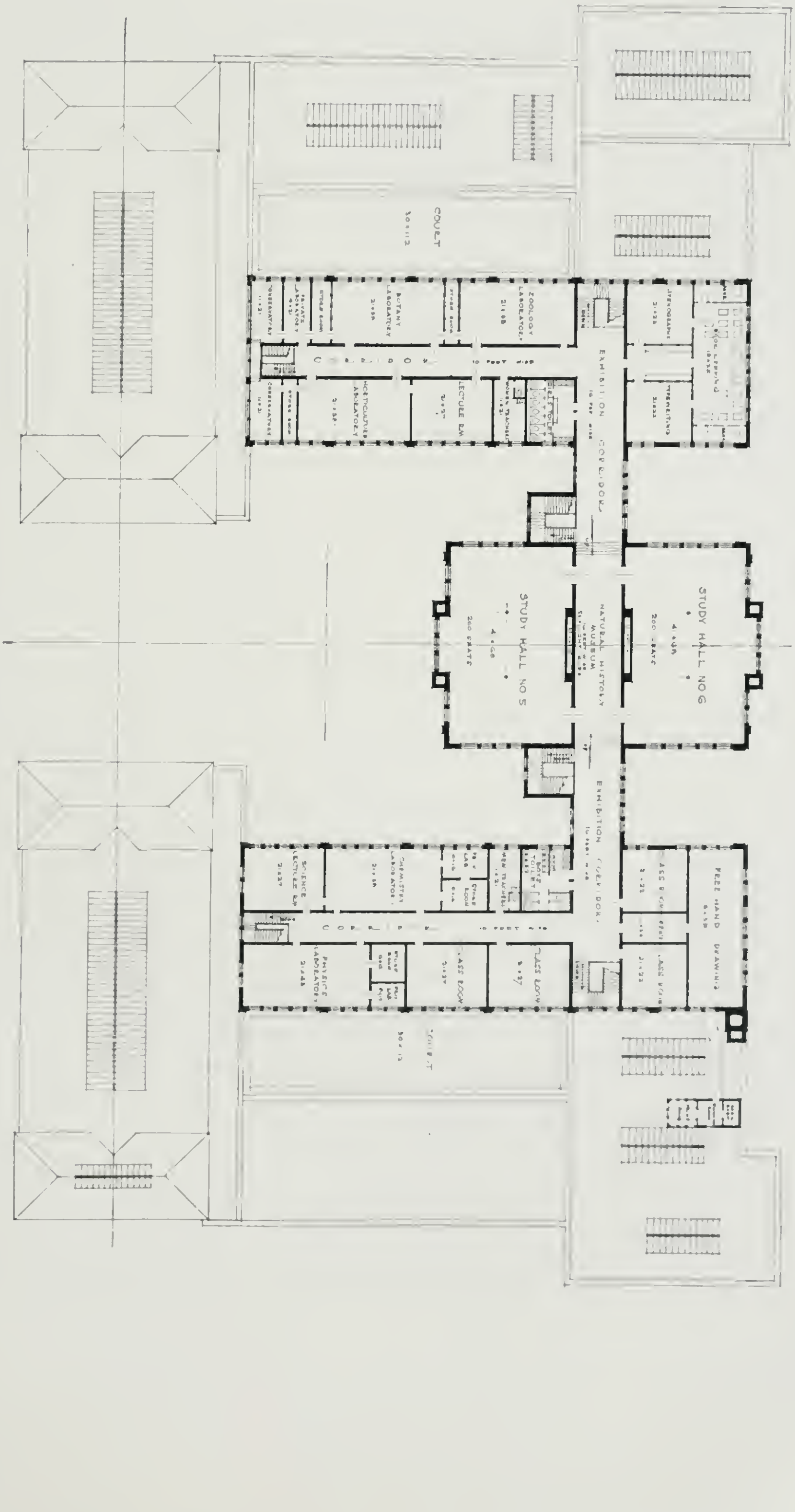
A MICHIGAN HIGH SCHOOL.
Perkins, Fellows and Hamilton, Architects, Chicago, Ill.



FIRST FLOOR PLAN, A MICHIGAN HIGH SCHOOL.



SECOND FLOOR PLAN, A MICHIGAN HIGH SCHOOL.



THIRD FLOOR PLAN, A MICHIGAN HIGH SCHOOL.

LIBRARY, SCHENLEY HIGH SCHOOL, PITTSBURGH, PA.

THE HIGH-SCHOOL LIBRARY

THE DEPARTMENT AND ITS EQUIPMENT

Irene Warren, Chicago, Ill.

Until very recent years, any collection of books set up on shelves was referred to as a library. The mere spacing of walls so as to contain the shelving was deemed sufficient architectural planning, and the only prerequisite for librarianship was a fair degree of intelligence.

The public libraries of America testify to the great changes wrought since the year 1876 when a small group of men and women met at the Centennial in Philadelphia to discuss how the public library could be made a more effective educational agency in the community. In contradistinction to the old methods, the buildings are now planned to facilitate the many kinds of service public libraries render, the collections of books are thoughtfully chosen and are scientifically arranged to meet the public's needs, and the staff of highly trained librarians further serves the public by keeping in touch with the scientific, artistic, commercial, and social activities of the community.

A small number of high-school principals, within the last few years, have begun to see the inadequacy of scattered collections of books (for high schools have always owned books) and have been bringing them out of attic and basement rooms, ends of corridors, offices, and classrooms, and have tried to organize them into central collections with some one person in charge. The results have not been satisfactory in most cases because often the person placed in charge has been without special library training and the collections have been unskillfully chosen. Another and perhaps less obvious reason for failure is the fact that the schools have copied their library equipment and methods of administration from the nearest model, usually a public library or perchance a college library, without a realization of the fundamental differences underlying the purposes of these different types of libraries. This has been a great handicap to success. The small, good-looking reading rooms that they fitted up did not and could not function. None of the schoolmen have been willing to give adequate space or sufficient funds for books and librarians and to work out a plan whereby pupils could actually get the use out of the books. The brevity of this paper permits only the statement of the fact that the schoolmen as yet have not given the school libraries much consideration without going into the reasons for the situation. But an attempt will be made to show that the excellent educational methods advocated for our high schools today, cannot be carried out successfully without the help of a well organized and efficiently administered library adapted to the particular needs of the high schools. The points made here, taken partly from the practices of different high schools scattered across this continent and partly from the tendencies in education today that should affect our problem, it is hoped, will stimulate educators to start constructive measures along this line and will convince architects that plans for school libraries should be made before the buildings are erected.

Theoretically, many educators believe that the school library should be in active relations with all the pupils and all the departments of the school. There is no subject in the high-school curriculum but has its body of literature. A subject without an intellectual content has no place on the curriculum. Some departments to be sure, are much more dependent upon literature than others. Practically then, our problem is to advise a plan whereby the literature of every subject in the curriculum is readily available to every pupil and every teacher.

It would seem logical to expect that the first two points to be considered in locating the library in the high-school building are (1) that the library should occupy a central location in the building and (2) that such departments as English, history, civics, and others that use it most frequently should be grouped about it. This is not however in accordance with the usual practice.

Further details of the location depend upon the purpose determined that the library shall serve. Some educators believe that the high-school library should serve only high-school pupils and teachers, and that the various private and public libraries should take care of the rest of the book needs of the community. There is

another group of educators, and this includes a number of prominent librarians, who think that the school library should be a branch of the public library and serve not only the school, but the community at large. Advocates of the wider use of the school plant will doubtless see much in favor of this plan. This does not preclude intensive work with each department of the school, but it generally means that the library must be placed where it can be operated after school hours without lighting or heating the whole school and where the general public can be most conveniently served. Rooms on the first floor, with one outside entrance and one leading into the school corridor are best adapted to this plan. That library will obtain the most desirable results, that makes its activities follow most closely the policy of the school, whether this includes night school, junior high school, junior college, or the community at large. The policy of the school should determine not only the place of the library in the building, but also the seating capacity necessary, the size and character of the collection of books, other material needed, and the kind of administration required. Whatever use is made of the school and the school library for community purposes, it should be clear that the school library must always be equipped and run so that it will serve first of all the pupils as pupils, and the community features must be kept sufficiently separate and distinct so as not to interfere with this primary use.

In considering the size and the place of the school library it should be remembered that the library is more closely related to the study and study periods of the pupils than to any other phase of the school work. The teachers using the textbook as a guide only, require pupils to read many other references and examine pictures, slides, museum specimens, and other so-called "visualizing material." This material should be placed in the library because it will receive much wider use there, and also because many departments have collected much more material than their teachers, untrained in the scientific arrangement of materials, can readily manage in the department classrooms. A prop-

LIBRARY, TRENTON JUNIOR HIGH SCHOOL, TRENTON, N. J.

LIBRARY, GROVER CLEVELAND HIGH SCHOOL, ST. LOUIS, MO.

erly organized and equipped library, with reference materials at hand affords the best study-room for pupils.

A little thought convinces us of the absurdity of study in barren assembly halls and classrooms, apart from the material we require pupils to use. That also entails excusing pupils for trips to the library in search of references that should be at hand. If the library and study room cannot be combined in one, place the library adjoining the study room so that pupils may pass freely from one to the other.

The library should be regarded as a department in the school on the same basis as the other departments. One room seating 25 pupils in a high school of eighteen hundred or two thousand pupils is wholly inadequate. It requires a suite of rooms—a reading room, a classroom, and a work room. Determine the space allotted to the library department by the

1. Number of pupils in the school.
2. Number of pupils studying at any given period.
3. Type of service the library is to give.
4. Physical equipment necessary.

One librarian cannot look after more than 125 pupils to advantage at one time. In a room where there are more pupils than this, the accumulated noise incidental to the business of the place interferes with quiet study and the librarian who must maintain order in an overcrowded room, has no time for real work as study assistant. These facts should limit the size of the reading room. If more space for reading room purposes is needed, as it should be in the larger high schools, plan reading rooms adjoining each other, with glass partitions and doors leading from one to the other so that the collections of one room may be readily accessible to the others. In our largest high schools four such rooms would probably be necessary—two for the large freshman class, one for the sophomores, and one for the juniors and seniors. The combination of library and study-rooms might not, however, require a larger building, but only an adjustment of space and study periods. If principals think facilities for instituting this plan thruout the four-year course are not favor-

able, they are advised to make the beginning in the freshman year in the hope that the improved methods of study will keep the children in school at least during the first year and perhaps give them the impetus and methods that will make them continue to the end of the course.

Outdoor reading rooms may be added to advantage in such climates as will permit their use for any large proportion of the year. Even if this is but an outdoor balcony or a small closed court, it will add charm and comfort. For the anaemic and nervous children, it will be a help in restoring health.

The details of equipping a high-school library will be discussed in a later paper, but in determining the size of the reading room it may be well to call to mind the larger pieces of furniture such as

Reading tables or desk.
Chairs or seats.
Loan desk.
Shelving.
Catalog case.
Magazine rack.
Bulletin boards.
Case for over-size books.
Display rack for new books.
Cabinet for picture collection.
Cabinet for lantern slides.
Map cases.
Museum cases.
Phonograph and cabinet for records.

Lighting is an extremely important problem in the reading room. The windows should be so arranged that the light will fall over the reader's left shoulder and that the glare of the sun will not fall on the open books. Some librarians prefer large windows placed high in the walls, shutting out street attractions and giving more wall space for shelving. If the windows are placed low in the walls, awnings or hoods to the windows, vine-covered pergolas and lattices may help to soften the light, shut out distracting sights, and add to the attractiveness and comfort of the room. Even if the room is used only for daytime purposes, artificial light should be provided, both gas and electric if possible. A dark day or a dark hour is very upsetting to a room full of young people. If the room is to be used in the evening a good indirect lighting system should be installed.

Every librarian knows well that Morpheus is specially apt to tempt people when they sit down for meditation or study in a quiet room. Stagnant air and high temperature increase this trouble. A library is with difficulty kept free from dust and dirt, and it is impossible to keep the air fresh when it is constantly filled with people, unless special attention is given to the ventilating system.

Confusion and congestion otherwise necessary in the reading-room may be relieved by providing the librarian with a work-room where books may be unpacked, sorted, mended, and prepared for the shelves and where books not in commission for one reason or another may be stored. A considerable number of supplies must always be kept on hand. All this requires cupboards tables, writing desks and plenty of shelving. Every high school librarian must spend much of her time during school hours at the charging desk and leave the other work for odd moments. If the work-room adjoins the reading room and the charging desk is set into the glass partition separating the two rooms, it will save the librarian's time and energy. Place the charging desk where she may command a view of the entrance and at the same time supervise the reading room. A window closing down on the charging desk will shut out the noises of the work room, the use of the typewriter and unpacking books, noises very disturbing to readers. Window shades or hanging curtains may be so placed on the glass partitions so as to hide unsightly parts of the work-room from time to time. Running water in the work room is a necessity because the librarian needs it often in mending books, mounting various kinds of material, and also because the dirt in the books makes it necessary for her to wash her hands very frequently.

Equip the classroom not only for training students to use books and libraries (and every high school needs a course of instruction in this line as much as it does in history, domestic science or any other subject) but equip it so that the teacher in any subject who wishes to use a large amount of material may take a class there for a lesson. It should therefore be large enough to seat any class in the school, be supplied with tables and cases adapted to the exhibition and examination of material, should have a screen for the lantern and a phonograph for the use of language and music records. Provide some museum cases for special material. Carefully prepared exhibits should be made up from time to time to illustrate the classroom work and these should be kept in this room. To avoid noise and confusion have three entrances for the classroom, joining it with the reading room

LIBRARY, HIGH SCHOOL, YPSILANTI, MICH.

and the librarian's work room. Use the third door leading into the corridor only in receiving and dismissing classes.

Many poorly equipped libraries have succeeded in doing some excellent work in spite of their poor equipment. Had they had the advantages of proper location in the building, adequate space and equipment, and been operated under scientific management, in place of the "do-anything-you-can-method," many of their efforts might have produced permanent instead of temporary results and laid the basis for expansion and intensified development. "The waste in work not done, or done with the wrong method, is a serious economic waste."

Not so many years ago each teacher was expected to do everything except janitor service—and some even did that. Now we have specialization in teaching, and with it has come the assignment of school libraries to trained librarians who stand ready to co-operate with both student and teaching forces. Before this it was customary to have teachers or principals' clerks give the library such care as they could when not engaged in the regular duties for which they were employed and the practice continues in many high schools today. The librarians who have gone into high schools have worked against odds because there is no equipment on the market specially adapted to their needs and the pressure of daily demands in the school has forced them to accept whatever equipment the school chanced to have or would provide without delay, or whatever they themselves could find that would serve. Satisfactory results cannot be hoped for until a detailed study has been made of the particular needs of the high school library and an equipment planned to meet these needs in much the same manner that special equipment has been worked out for science laboratories and for the courses in domestic science, art, manual training, and bookkeeping.

This brief paper can state only a few of the important questions involved in equipping a high school library, give some of the best plans and devices in practice at the present time and

Paneled Front of Wing-type Charging Desk.

suggest some of the problems that most need our attention. If we can standardize the work of our high school libraries even a very little more in some lines, we can secure at a fair price from the supply houses many needed articles which when manufactured for the individual institution are prohibitive both in cost and time spent in designing and constructing.

We have two prime factors to consider in establishing a high-school library—the pupils and the books. The books have but one purpose in the school and that is to serve the needs of the pupils. Therefore one of the first questions we must settle is that of the seating arrangements for the pupils in relation to ease in using books. There are four methods in practice at the present time.

1. Seating at standard library tables.
2. Seating at one side of slightly sloping narrow tables.
3. Seating at regular school desks.
4. Seating in assembly chairs (usually when books are kept in an assembly room used for study purposes) or in chairs provided with writing arms.

Unit Wood Shelving built in sections 3 ft. wide, 4 ft. 6 in. and 6 ft. 10 in. heights, single or double faced, with shelves 8, 10, or 12 in. deep.

The desired atmosphere of a library is more easily maintained if library tables are used. These should not seat more than eight or ten pupils. If they are larger the librarian has difficulty in getting around them quickly as she often needs to do. The best narrow sloping tables on the market seat but two pupils. It would be better if they were long enough to seat three or four and thus save aisle space. These narrow tables permit all pupils to have the lighting from the best direction and give a room

A Magazine Rack with drawers for storing pamphlets and pictures.

which is much more easily supervised because all pupils necessarily face in the same direction and have no temptation to communicate with those opposite. Assembly chairs are not adapted to study or reading purposes as is readily seen without explanation. The armchair does not furnish enough space for the pupil who, most of the time must spread out his work, draw maps, charts, or illustrations, or compare several books. It is, however, a good plan to have a few arm chairs in any library to take care of the irregular pupils, to provide additional seating in rush times and to allow restless pupils to shift

Charging Desk fitted with sunken charging trays, covered by roller curtain, cash drawer, registration trays, book shelving, drawers and cupboards for miscellaneous uses.

their positions. Even if pupils are provided with plenty of locker space they must often carry considerable material about with them when they study. It would be advantageous if chairs or tables could be designed which provided racks where pupils might deposit books and papers when not in actual use.

It is without doubt possible that if an educational psychologist would turn his attention to the conditions under which students study and read to the best advantage, his conclusions would supply the basis for designs for more suitable furniture than we now have and for a more satisfactory arrangement of our reading and study rooms. Until such a time as this investigation is made, librarians must content themselves with the experience gained by as careful observation as they may be able to give when not pushed too hard by daily routine.

Magazine and Newspaper Racks composed of two 3 ft. units with storage cupboard, sloping shelves, newspaper racks and files.

Shelving may be arranged in one of two ways, around the walls or in stacks. The wall shelving makes a more attractive room and one easily supervised. If the shelves are grouped in stacks they should be placed at one end of the reading room near the librarian's desk so that she may quickly get the books wanted. The alcove arrangement of shelving is not adapted to a high school, because the wide secluded spaces between the rows of shelves tempt forbidden action and conversation.

Wooden shelves are preferable to steel in a small room. There is an excellent wood shelving on the market that may be bought in sections. Shelving should never be higher than the average pupils can easily reach—probably seven tiers in all. The length of shelves between uprights should not be more than three feet or the shelving will sag. The shelves should be plain in design and adjustable. There are a number of pegs and devices for sale to be used in constructing adjustable shelves. Shelving made in units has the advantage also of being moved from place to place more easily than that which is permanently built in. It is, of course, possible for an architect to construct shelving according to the measurements here given but it is rarely as well constructed as that which may be purchased from the best supply houses.

As was suggested in the previous paper, the charging desk should be placed near the entrance so that the librarian may readily see who comes in and goes out. Pupils who wish merely to borrow or return books or ask for information at the charging desk may then do so with the least possible disturbance to the readers. There are stock charging desks on the market but usually the high school librarian prefers to design one specially adapted to her individual needs. If this desk is set, as has been advised, in a glass partition separating the reading room from the librarian's work-room, it is in the most convenient location. The counter portion of the charging desk should be about two feet in width and eight feet in length. When the rush hours come, several people may then assist in charging and discharging the books, and have sufficient room so that material will not be falling on the floor. Avoid sharp corners on the counter. Under the counter, there should be drawers for

A combination of typical sections for card indexes, pamphlet cases, slide cabinets, picture boxes and sliding shelves for large books.

the supplies needed for the charging of books and shelves on which to place the books returned. A slightly raised platform for the librarian gives her a better chance to supervise the room.

All devices for noise prevention are desirable. A cork carpet, while somewhat expensive, wears well and is the only satisfactory floor covering as far as preventing noise is concerned. Swing the doors one way and furnish them with springs that will close the doors quickly and noiselessly.

Every modern high school subscribes to current magazines. A stock magazine rack is illustrated here, and one provides drawers for the back numbers until such a time as the magazines are bound. A similar rack may be used for railroad folders, advertising material and other ephemeral pamphlets used by the classes.

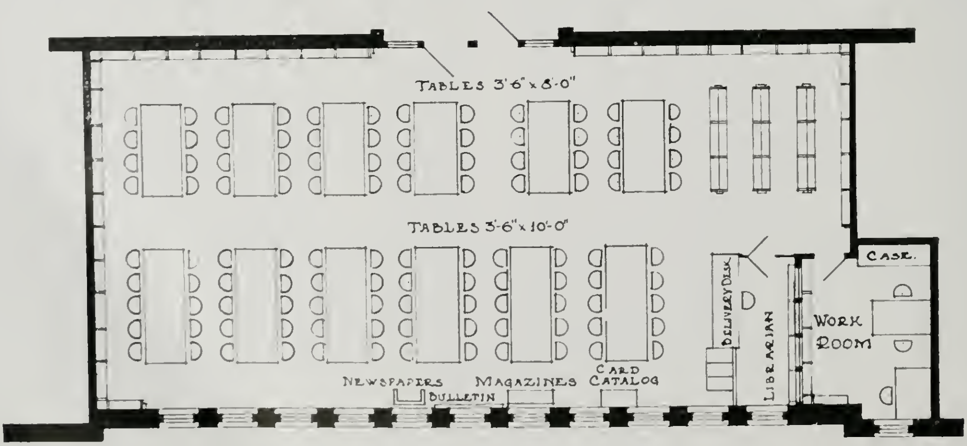
Low, extra-deep shelving provided with rollers is the best for the very large atlases and art books so that they may lie flat. Sometimes the bottom shelf of the regular shelving is made

A Vertical File Section for storing pictures, etc.

extra wide and high or one whole section is built for over-size books.

Shelving, specially designed for exhibiting books, should be placed at the front of the room for new books and special exhibits, in order to attract the attention of all who enter the room and also to keep noise and disorder near the door.

Place all lists of books which the teachers assign the pupils to read in the library where the pupils may easily refer to them when they wish to read the books. Bulletin boards for this purpose should be erected and the space allotted to each department should be in constant use. The best bulletin boards are made of cork, and



Plan of Furniture for High School Library, Spokane, Wash.

framed with a narrow moulding corresponding to the woodwork in the room. If covered with celluloid or glass the papers may be kept cleaner and in better order. A small blackboard built in the wall is a great convenience when it is necessary to give notices to all pupils in the room in a short time.

A good type of Newspaper and Magazine Rack.

The card catalog case should be purchased from some reliable supply house, for if the cards do not fit rightly in the drawers, their edges soon wear rough, the cards are torn, and the catalog must be rewritten. Other pieces of furniture may be built by the local carpenter or the manual training department, but the catalog case demands too careful measurements to make it worth while to construct it outside of a factory built for that purpose.

It is as important to have the pictures and lantern slides kept in a central organized collection as it is to have the books and for the same reasons. A vertical filing cabinet, similar to that used for filing correspondence is the neatest and most convenient way of keeping the pictures and a cabinet resembling a card catalog case is the best one for the lantern slides.

Have one or more museum cases in the library where special teachers may place materials referred to so that pupils may study the specimens when they are reading about the material in the books. Distribute other museum cases about the corridors. Drawers and cupboards should be provided in the store room for specimens not on exhibition.

Tint the unoccupied wall space which may be seen above the book shelves and bulletin boards some restful soft brown or grey color. It will serve as a good background for pictures, statuary and flowers. The art classes can help in making the library attractive not only by providing mural decorations but also by designing and lettering bulletin boards, special notices and like small things.

Plans for high school libraries and their equipment may be secured from the following sources:

Chairman of the High School Committee of the Library Section of the National Education Association.

Librarian of the U. S. Bureau of Education, Washington, D. C.

Secretary of the American Library Association, 78 East Washington St., Chicago.

The secretaries of the State Library Commissions (located at the capital of the state) can

A good type of Rack for New Books. Top panel is used for Bulletins and Book Lists.

always give information about where help in this line can be given for a particular state. Many valuable suggestions may be gained by consulting the recent numbers of the Library Journal, Public Libraries, the English Journal, and the Proceedings of the National Education Association.

Note.—For the use of photographs and plates illustrating this article we are indebted to the Library Bureau, Boston, and the Globe-Wernicke Co., Cincinnati.

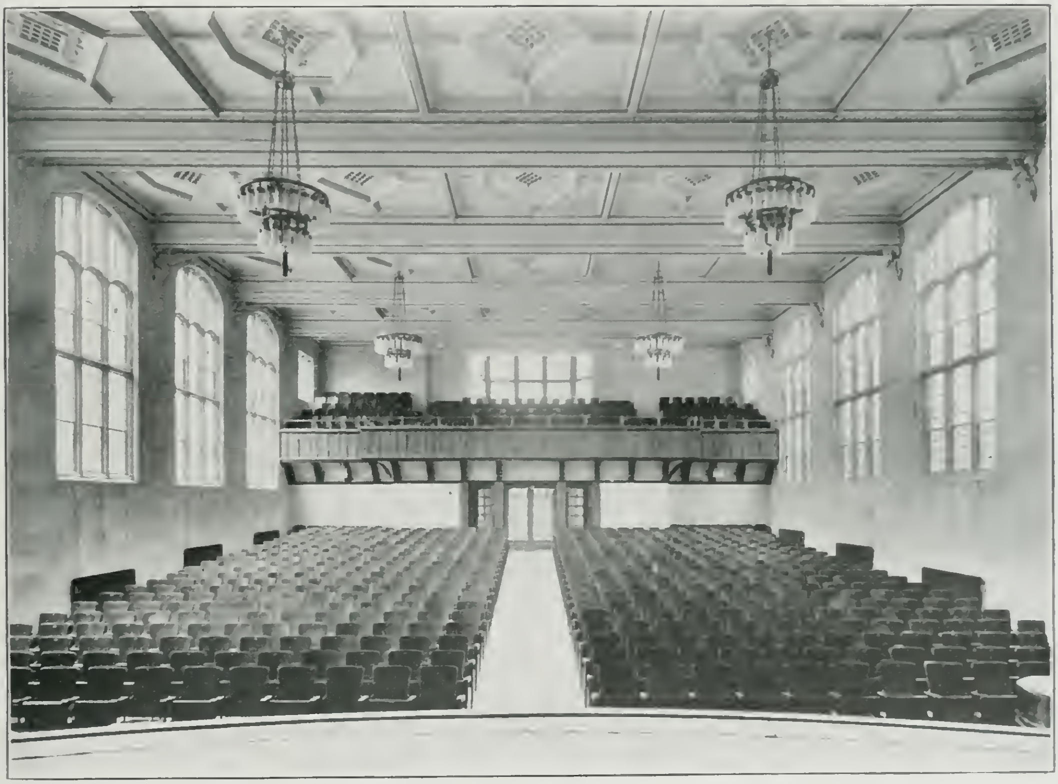
LIBRARY OF THE McCLAIN HIGH SCHOOL, GREENFIELD, O.

Wm. B. Ittner, Architect, St. Louis, Mo.

ASSEMBLY HALLS

JAMES O. BETELLE

Illustrations taken from the work of E. F. Guilbert and Guilbert & Betelle, Architects



AUDITORIUM, NEWARK STATE NORMAL SCHOOL, NEWARK, N. J.
Rear View Showing Gallery. Size 54x75 Feet. Capacity 757.

It is generally agreed that the assembly hall has become a necessary part of the modern school building. We shall accordingly not argue for its existence, but rather discuss its betterment in general appearance, seating accommodations, stage arrangements, lighting, acoustics, and other important elements. At the same time we shall avoid recommending any extravagances or unnecessary costs.

School assembly halls must fulfill requirements that were not thought of a few years ago. When provided with a good stage, assembly halls not only are used for ordinary school exercises, but afford the pupils the opportunity of presenting plays and permit the public to enjoy evening lectures, etc. In the much discussed wider use of the schoolhouse these rooms are most commonly employed and are frequently opened to civic and social organizations.

It has been conspicuous not only to principals and teachers, but to the parents that the modern assembly room of the well-designed and well-furnished school building is noticeably agreeable to the pupils, and is often the subject of comparisons with the older buildings they are familiar with. When a little effort is spent on the appearance of the assembly halls these rooms have been especially complimented by the pupils and the public.

One of the greatest differences between the old and the new school assembly halls is their position with relation to the general structure.

In years past it was usual to build the assembly room in the upper story or roof where apparently it could be placed with the least cost. Not infrequently the room was provided with very poor exit accommodations.

The modern auditorium is always near the ground; sometimes it is as low as the basement floor; it is never above the second floor, but in more than seventy per cent of the newest buildings it is placed on the first floor. Great attention is given to exits, and the advantage of their being at grade level is obvious.

The best service of an auditorium to the school can be secured by placing it in the central portion of the building rather than at one of the extremities. In size, it should accommodate the entire student capacity of a high school; in grammar schools it will meet all requirements if it cares for fifty per cent of the pupils at one time. Large buildings which take the form of a hollow square are frequently arranged with the auditorium in the heart of the structure, entirely surrounded by corridors and classrooms. The auditorium is here lighted from above or from large courts on either side.

It is important that auditorium seating be arranged so that every seat has an unobstructed view of the stage. This necessitates the careful working out of sight lines to determine the slope of the floor, the height of the gallery (if any), and its slope.

AUDITORIUM, SOUTH SIDE HIGH SCHOOL, NEWARK, N. J.
Size 62 feet by 75 feet. Seating capacity including gallery 1275

The seating capacity of an auditorium may be determined very closely by taking the area of the room in square feet, including the gallery if there is one, but excluding the stage and dividing by 6½—the number of square feet allowed for each person. The result will be very nearly the exact seating capacity of the room including space for the aisles. The seats should be spaced at least 30 inches, back to back, and 32 inches is more comfortable. The width of the seats from arm to arm should be not less than nineteen inches; seats twenty inches wide are more desirable if the space can be afforded.

The width and spacing of the aisles are governed in the larger cities by the local building ordinances; they are the same that apply to theaters. The best practice seems to require that the aisle with seats on both sides be at least 3 ft. 0 in. wide at its narrowest part, and that it increase in width toward the rear of the room at the rate of 1½ inches for every five feet of length. The various building laws seem uniform in the requirement that no seat should have more than seven intervening seats between it and the nearest aisle. This practice does not permit of more than fifteen continuous seats in a row when there is an aisle on both sides, or more than eight seats in a row when there is an aisle only on one side.

When the seat aisles have been well arranged, it is not necessary to raise the stage high above the audience floor in order to place the entire stage in good view. A comparatively low stage overcomes the awkwardness of necessitating the front rows to look directly at the feet of the speaker and to hold their heads at an unpleasant angle to see his face. This defect is conspicuously apparent in platforms of many old school auditoriums in which the stage is nearly four feet high. A height of 2 ft. 6 in. is quite sufficient if the auditorium floor is properly designed.

It is, of course, desirable to provide a large stage whenever practicable as there are occasions, particularly at graduation, when a large number of persons should be on the stage in full view of the audience. However, stages sufficient to meet these requirements if forced upon the plan, sometimes involve great expense or the sacrifice of other desirable features of the plan, and many educators argue that a small stage which meets the needs of the 99 occasions out of the possible one hundred, is quite acceptable. For commencement or a similar exceptional occasion, the graduates may occupy the foremost rows on the main floor.

From point of appearance, the reasonably small stage is more desirable than very large

AUDITORIUM, GARFIELD SCHOOL, NEWARK, N. J.

one. An anteroom on either side should be connected with both the stage and the corridor. Sometimes the plan so provides that but one anteroom may have corridor connection. Such an arrangement is most awkward, particularly when it forces a speaker to walk down the aisle of the room filled with people, to disappear into the anteroom and to reappear from there on the stage. Such an arrangement is also very unsatisfactory when the pupils produce a play.

Except in the very largest and most elaborate buildings, very few school stages are built with a view of using drops, flies, wings or elaborate scenery. As soon as elaborate scenery is used, structural complications and expense begin to multiply as the building then comes into the theater class. On account of the increased dangers, theater buildings are required to have elaborate precautions against fire and smoke. These include such arrangements as a skylight over the stage, a water tank on the roof, a sprinkler system, etc. The cost in such cases becomes prohibitive when the few advantages gained are considered.

A stage curtain, however, is usually installed and should be given very serious consideration from a decorative standpoint, as it is one of the principal decorative features of the room and is in full view of the audience when closed. On account of the wide opening of the proscenium arch, most curtains are divided in the center and each half is drawn to one side. To attempt to operate the curtain up and down on a wood or metal roller is practically an impossibility, when the length, thickness and weight of the roller, which would have to be raised, is considered. The best material to use for the curtain is velour, of a brown, old gold, or blue color. To relieve the large expanse of plain material, the curtain should be decorated with bands and borders of silver or gilt galloons, worked out in ornamental design. To make the curtain hang better and to weight it at the bottom, a border of heavy fringe and tassels is often used.

AUDITORIUM, CLEVELAND SCHOOL, NEWARK, N. J.
Size 60 feet by 77 feet. Seating capacity including gallery 830.

The curtain is opened and closed from the dressing rooms at the sides, and moves on wheels overhead in a sliding door track. Provision is also made at the top to adjust the length of the curtain, as any material in such large pieces will sag and stretch of its own weight and drag unpleasantly on the floor. At the top, to hide the tracks and operating ropes, it is usual to place a valance, which remains in place and does not move the curtain. The valance lends itself to effective decoration by the use of the school monogram or other ornamental device, worked out in galloons or colors. While not absolutely necessary, the velour curtain is sometimes lined on the inside with a fireproof duck lining of the same color as the curtain. This gives a more attractive finish to the inside of the curtain and adds a certain fireproof quality which is well worth while.

All curtains should have a fullness in the material; that is, when closed tight, they should hang in folds and not be stretched flat. To make the proper folds or plaits in the curtain, extra material of one-third to one-half the width of the opening is required. Back of the valance, besides the tracks and ropes for the sliding curtain, and out of view, is located the stereopticon screen, rolled up on a large wooden roller, about 15 ft. or 20 ft. long. This is lowered by means of ropes from the side dressing rooms, and is always in position for instant use. It obviates the trouble of stretching a loose cloth sheet in place as so often is the case. When lowered the screen can be nicely framed in by drawing the curtain close up to its sides, thus avoiding any objectionable view around the sides or back of the screen, if the latter does not occupy the full width of the stage opening.

AUDITORIUM, HIGH SCHOOL, EAST ORANGE, N. J.
Size 75x85 Feet. Seating Capacity 1,200.

The furniture used on the stage is another item not always given the consideration it deserves. The ordinary school furniture which one often sees on auditorium stages, is entirely

out of keeping with the formal character of a platform, and heavier and larger furniture with a finish in harmony with the color scheme of the room should be selected. Ordinarily a settee, large enough for three persons, two arm chairs and two side chairs are all that is necessary for the good furniture. Any other chairs necessary can be brought in and removed temporarily as required. It is also desirable to have at least two taborets, or small tables, for flowers, books, or other miscellaneous purposes. The reading desk should be of good design and not of the usual "Church" character so often seen. The accompanying illustrations show various stages where good furniture has been used. The stage carpet should be of a simple color to harmonize with the decorations and the stage curtain, and not a rug of striking color combinations. It should be fastened in the floor by pins and sockets so that it can be readily removed, when a raised platform is to be built on the stage, and replaced again without trouble. Behind the stage there should be ample space in order that when the curtain is closed the stage may be properly set. In front of the curtain, to the edge of the stage, at least six or eight feet should be available so that when the curtain is closed, there will be sufficient space for the reading table, chairs, etc., for chapel exercises.

The lighting fixtures should be given consideration from a decorative as well as from an efficiency standpoint. While simple in outline, they should be of proper size and proportion and in the same style as the room. When they are located near the ceiling in a high room, it is of great convenience to have them so arranged that they may be lowered from the roof space above for cleaning and renewing the lamps. Indirect lighting which is now receiving a great deal of attention, and which is somewhat more expensive in electric current consumption, is well worth the difference in the added comfort to the eyes of the audience.

Over each exit door should be placed a gas or an oil lamp, with a red globe, to locate the exits in case of emergency. These lamps should

AUDITORIUM, MORTON STREET SCHOOL, NEWARK, N. J.
Size 51 feet by 79 feet. Seating capacity including gallery 751.

be lighted at all times when the auditorium is used in the evening. Nothing starts a panic more readily than the failure of the electric lights. This is likely to happen in case of a heavy storm or trouble at the central power plant. All precaution should be taken for safety in such an event.

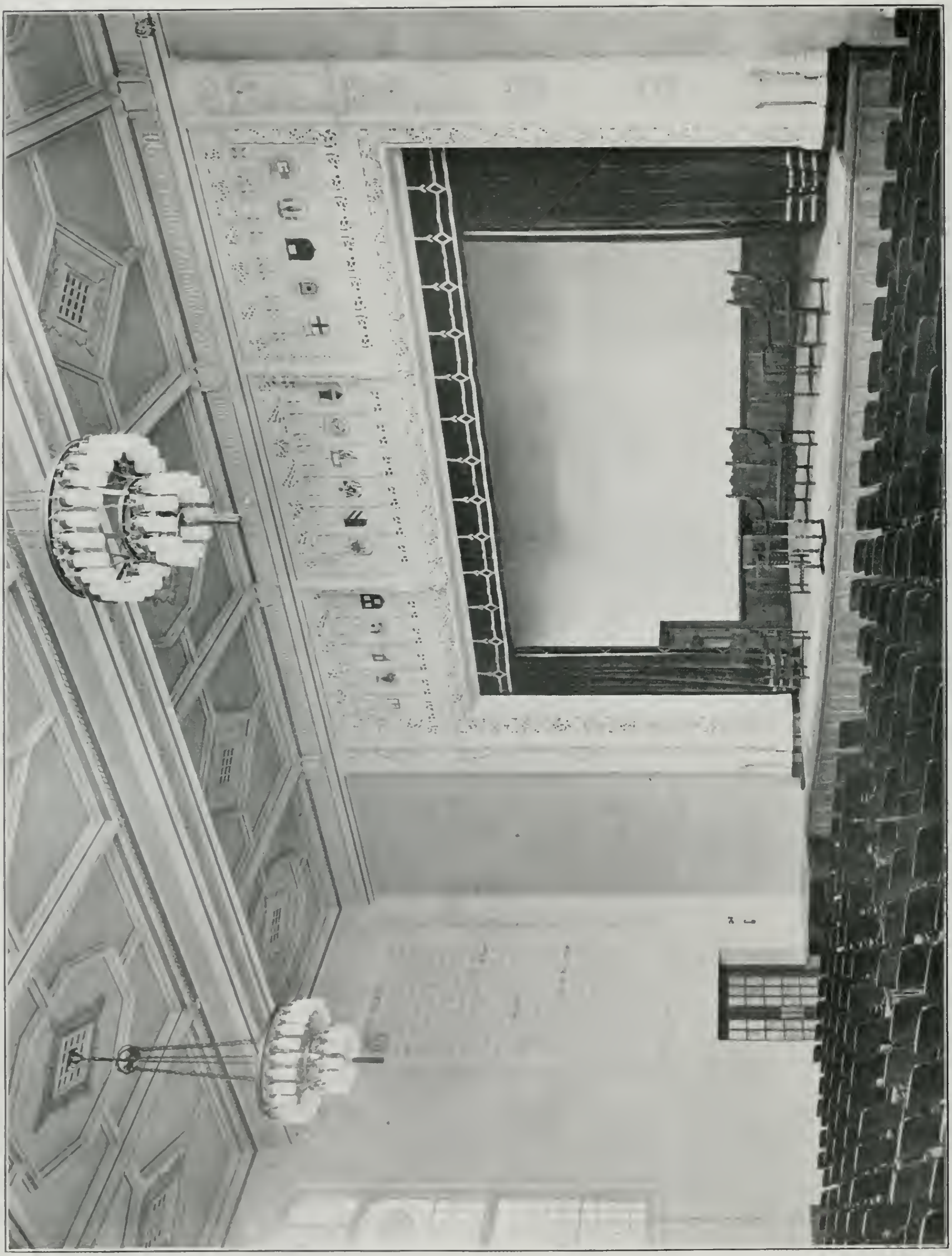
Footlights are installed in a gutter across the front of the stage and when not in use, are protected with removable board covers. In smaller buildings, built-in-foot-lights are often omitted and an electric outlet is set in the floor to attach portable footlights when needed. To make the stage the most brilliantly lighted part of the auditorium, overhead lights or side lights fitted with reflectors, are installed back of the proscenium arch and out of view of the audience. Electric base plugs are placed around the sides and rear of the stage to permit the use of table-lamps, fans, etc. Outlets for water and gas are usually installed in the center of the footlight gutter for use when lectures of a scientific nature are given, or other demonstrations are made.

In addition to the stereopticon, the motion picture is taking an important part in the education of today. The strict rules regulating the use of motion picture apparatus have made some special provisions necessary to overcome the fire hazard.* In addition to the usual requirements, it has been found that the lights in the auditorium should be controlled not only from the dressing rooms at the sides of the stage, but also from the motion picture booth. A main switch should be installed here so that the picture operator can turn on or off the lights, whenever desired. A signal buzzer from the stage to the booth is also a convenience for the lecturer in controlling the display of the pictures.

Provisions for darkening the auditorium in the daytime should not be forgotten. Where side windows occur, opaque shades in addition

AUDITORIUM, MADISON SCHOOL, NEWARK, N. J.
Size 49x57 Feet. Seating Capacity, Including Gallery, 501.

* See American School Board Journal, January, February, March, 1914.



AUDITORIUM, NEWARK STATE NORMAL SCHOOL, NEWARK, N. J.
Size 54 feet by 75 feet. Seating capacity including gallery 757.

to the regular curtains are all that is necessary. When the room is lighted by an overhead ceiling light, it can best be darkened by a heavy canvas on a wood roller over the skylight on the outside. The use of opaque shades under the ceiling light and visible in the auditorium is a very unsightly and complicated arrangement with its many strings, wires and dusty shades which are so hard to keep clean.

For the sake of economy, it sometimes is desirable to use the auditorium as a combination auditorium-and-assembly hall, or as a combination auditorium-and-gymnasium. Needless to say the use of an auditorium for several totally different purposes is not desirable, except from the standpoint of cost. It is impossible to design a room which will be ideal for any one purpose when it must be put to a number of different uses. When used as a study hall an auditorium requires only the installation of chairs with hinged tablet arms, which can be dropped down out of the way when not used for study. Tablet arms are not placed on all the seats, but only on 100 or 200 in the front portion of the room. Only every other chair is equipped so as to give elbow room and to allow space on the intervening chairs for the pupils' books, etc.

When the auditorium is used also as a gymnasium it should be designed frankly as a gymnasium with a stage at one end, rather than as an auditorium with gymnasium apparatus hung on the walls and ceiling. A highly finished auditorium is poorly suited for the rough uses given a gymnasium, and if used as such, soon becomes badly soiled and scarred. There is no great objection to the use of a gymnasium as an assembly hall. Everyone appreciates that he is seated in a gymnasium and is not disturbed by seeing apparatus hanging from the ceiling and the walls. Such double use of an auditorium necessarily requires a level floor and movable seats.

Where the auditorium is located in the center of the building with corridors all around, it has often been found advantageous to place windows in the sides of the room, on the gallery or second floor level. These windows serve not only to light the corridor, but can be used to provide additional space for the audience when the room is crowded to its capacity. In these openings, however, should be placed hinged sash with obscure glass, so that when desired the auditorium can be entirely closed off from the rest of the building and used for the rehearsal of plays, or for meetings not connected with the school.

Acoustics are a troublesome problem. While it is acknowledged that no positive or absolutely perfect results can be guaranteed, there are, nevertheless, certain general principles which should be kept in mind and followed as closely as possible. If this is done generally good results will follow. In the first place, the room should not be excessively high. In a high room an appreciable length of time elapses between the instant the sound is made and the instant when the reflection back from the high ceiling reaches the auditors. This produces an echo. The wall and ceiling surfaces are better if broken up by ornament and projections rather than when they are smooth and plain. A plain, smooth wall, of course, reflects the sound and tends to produce an echo, while one with projections tends to break up the sound waves and overcomes this fault. As a gallery tends to prevent the rebounding of all sound waves, a room with a gallery is usually better than one without. A comparatively soft plaster made of old-fashioned lime is better than a hard, patent adamant plaster as it has a tendency to absorb the sound waves, while an adamant plaster tends to reflect them.

In spite of all precautions it sometimes happens that a new auditorium is very hard to speak or hear in, and is otherwise defective from an acoustic standpoint. It is not fair, however, to judge an empty hall for an echo, because when filled with people the result is often very different. The people and their soft clothing tend to absorb the sound waves, and when defects are not too great they are often entirely eliminated. There are, however, many cases where corrective measures are necessary. The old-fashioned method of stretching wires across the room has long been abandoned as useless. It has been demonstrated that a soft covering over hard plaster walls absorbs the sound waves and overcomes the echo. There is now made especially for corrective purposes a heavy felt with which the plaster walls of a room are covered and formed into panels, as the size of the sheets of felt seem to make necessary. This felt in turn, is covered with a canvas and is then painted to match the decorations of the room. Such a simple expedient has been found to correct and make almost perfect the acoustic properties of some of the most important auditoriums in the country. In the writer's experience, when a large auditorium was being designed and its importance seemed to warrant it, an expert on acoustics has been called in for consultation and advice, and the small expense thus involved has been more than repaid by the satisfactory results accomplished.

The ventilation of an auditorium is a subject which cannot receive too much attention when

a building is designed. The good reputation of the school and those responsible for it, depends upon the comfort of the people comprising the large audiences which fill our school auditoriums many times during the year. These people are the taxpayers of the community and the real owners of the building, and as the auditorium is practicably the only room they use to any great extent, they do not hesitate to express their disapproval if everything is not as it should be.

Generally speaking, the most modern ventilating system distributes fresh air very thoroly thruout the area of a room, and does not depend on driving the air thru registers on the sides or rear of the room with sufficient velocity to carry it across one-half the room, and thus produce unpleasant draughts. Fresh air is now admitted thru a number of registers distributed in the area of the ceiling and drawn down and out thru numerous mushroom covered openings, evenly distributed in the floor under the fixed seats. This arrangement, when the very best system is desired, is made reversible so that in summer the air can be driven in at the floor and taken out at the ceiling, and during winter taken in at the ceiling and out at the floor level. Should the reader be interested in the subject of ventilation, he is referred to the excellent articles appearing in the January and February, 1915, numbers of the *School Board Journal*, by D. D. Kimball, President of the American Society of Heating and Ventilating Engineers. The subject of auditorium ventilation is ably covered in the last part of the articles.

Regarding the general decorative scheme which seems so much neglected in the average auditorium, dignified and beautiful results can be accomplished by the choice and use of a few simple colors on the walls and ceilings. As a rule these colors should be various shades of old ivory, buff or light gray. The heavy dark colors so often seen give an oppressive and somber atmosphere to the room, which is just the opposite of the effect desired.

The stage, proscenium arch and front walls of the room are those most in view of the audience and should be given the most attention. Usually the space between the top of the wood baseboard and the chair rail is given a fairly deep tone of buff. From the top of the chair rail to the cornice at the ceiling a lighter color is used, and the ceiling is made very light cream. The moldings around the proscenium arch and the ornament in connection with the same are picked out in colors to emphasize their importance. If money permits, (and it costs but little), the large plain wall and ceiling surfaces can be reduced and made more attractive by the addition of striped panels or colored stencils. As will be seen in some of the accompanying illustrations, lettered mottoes or inscriptions are often introduced into the wall panels with very decorative effect. A careful type of classic letters should be used, however, to avoid the appearance of the ordinary advertising sign.

Plaster casts are also introduced into the decorative scheme with good effect. They should however, be carefully considered as to the scale and size of the subject and also the space where the cast is to be placed. It often happens that two spaces of the same size on opposite sides of the room should be decorated. In this case the casts should not only be approximately the same size as to the general dimensions, but the figures or ornament in both should be of the same scale.

While it is always very desirable to paint the walls and ceilings of all corridors thruout a school building, the money for this purpose is often lacking. In any case, where the auditorium is decorated, the corridor directly in front of the doors to the auditorium, and the hall leading to the main entrance, should be decorated in harmony with the auditorium. It is very unpleasant to enter a handsome new building and find a beautiful auditorium, while every part of the building one passes thru to reach this auditorium is not decorated or painted. It is surely a sign that the money has suddenly run short, or that those having the new building in charge have been thoughtless.

The Heating and Ventilation of School Buildings

D. D. Kimball, President, American Society of Heating and Ventilating Engineers;
Member, New York State Commission on Ventilation.

There is annually expended in this country in the construction of new public and private school buildings approximately the sum of $102,000,000, of which vast sum about 10 per cent, or $10,000,000, represents the money expended for school heating and ventilating plants. Approximately 21,000,000 children spend one-third of their daytime in these buildings for forty weeks of the year. The importance of such atmospheric conditions as are conducive to their welfare thus appeals to us with a force that is compelling. It is of vast importance that we should know that the expenditure of such a sum of money is wisely made and that the best conditions possible are provided for the physical, as well as the mental and moral, development of this great army of the men and women of tomorrow.

Within the last few years a great deal of criticism has been directed against artificial ventilation, particularly in school buildings. This has been aired in the public press and thru trade journals in such a way as to lead to the belief that there is little or no merit in artificial ventilation and that much of it is made up of "devices of the devil" manufactured and sold by commercial interests for profit only, without regard to any merit or existing need. In the main these criticisms are unmerited, and without exception they are unscientific and ill founded. It may not be said that there are no grounds for severe criticisms of much of the ventilation work of the past, but the justification for such criticism lies in other than lack of knowledge or ability on the part of the engineers and may not be applied to the work of the best engineers under proper conditions.

The most of the failures of the ventilation work of the past may be justly attributed to insufficient appropriations for the installation of ventilating systems and for their maintenance and operation. Very many installations are incomplete, ill designed, and installed with the use of unsuitable or cheap apparatus and material.

The majority of ventilating systems for school buildings have, in the past, been designed by architects, contractors, and manufacturers of apparatus or patented systems. No injustice to the architect is intended by this statement, but architecture and engineering are two very different professions involving different training, experience and temperament. The field of the contractor and manufacturer is essentially different from that of the consulting engineer. Tho it be true that many of the large contracting firms maintain a force of engineers, the work of such engineers is especially that of caring for the installation of systems designed by others.

Noisy apparatus and systems are often urged as an objection to heating and ventilating plants, but the presence of noise of any kind is quite unnecessary and is evidence only of lack of skill in design or installation. Failure to maintain proper upkeep and repairs is responsible for many of the failures of ventilating plants. Were the upkeep and repairs of the school buildings themselves neglected to the same extent as occurs in the case of the heating and ventilating plants a great many buildings would annually become positively unsafe for occupancy.

Possibly the most frequent and the most serious cause of failure is the absence of proper skill in operation. It is annoying to note the number of plants which are operated by boys or janitors who know absolutely nothing of the rudiments of fuel burning or care of a steam plant or of a ventilating system. Such men waste daily fuel costing more than the gross amount of their wages. The loss in repairs and maintenance of the plant is more important still, and the loss in the efficiency of the plant is vastly more serious.

Often too, there are such restrictions applied by the authorities to the operation of the plant or the work of the janitor that the proper operation of the plant is impossible. If a school board directs that the ventilating plant must not be operated before December first, or after April first, regardless of outside weather conditions or the needs of the building, is it to be wondered that complaints of insufficient ventila-

tion are often heard? If the janitor is offered a bonus for saving coal, is it surprising that the ventilation suffers? If it be further required that he must at all times operate his fan engines, should it be regarded as remarkable that he removes the belt between the engine and fan? Thus he saves coal and yet operates his engine, but no air is being supplied to the building. Manifestly the building suffers for lack of ventilation, and the ventilating plant is charged with failure.

The ventilating plants for the school buildings of a certain city are designed by one department, their operation is supervised by another, they are kept in repair by another department, the fuel is purchased by still another department, and the janitors and firemen are employed by yet another department. It is remarkable that there is an absence of correlation in the work of the various departments, with the result that the systems remain in need of repairs, sometimes for months, during which time portions of the plant are not in use? Often improper fuel will be selected. Confusion results, and to a serious degree the successful operation of the ventilating plants is threatened.

Very few of the vast number of school buildings erected in this country are provided with automatic recording instruments to determine the efficiency of the operation of the heating and ventilating plant, either from the standpoint of fuel consumption or as to the results obtained in the building. Such instruments intelligently used would largely reduce operating costs. In very few instances is there any system of supervision to assure the proper maintenance of the economical operation of the school ventilating plant. In a few instances such supervision is in vogue with results in economy and efficiency which have more than justified the expense of the system of supervision. These, and other similar conditions might be cited to explain failures of artificial ventilating systems, but therein is no ground for the condemnation of the artificial ventilating system properly installed and properly operated.

A criticism which may possibly be directed against heating and ventilating engineers is that they have too often submitted to the imposition of conditions making success impossible, usually due to restricted appropriations for the installation of the heating and ventilating plant. It is to be regretted that every consulting engineer will not decline to undertake the design of a plant for which a sufficient appropriation is not made, just as it is to be regretted that a school building committee will insist that an architect shall undertake to provide plans for a larger building than may be well built for the money available, or that other committees will insist upon an ornamental structure or the use of stone, marble or other decorative materials at the expense of the heating and ventilating equipment, even tho the latter is that element of the building which means most for the health and comfort of the children.

Largely as a result of the criticisms directed against the artificial ventilating system many investigations and experiments have been conducted, some of the most important being those of Fluegge, Hill, Milner, Benedict, Lee, Crowder, Winslow and Baskerville, the work of the New York State Commission on Ventilation, and experiments in the Boston and Minneapolis schools and elsewhere.

Out of the vast amount of work that has been done has come a realization that, altho the volumetric standards of the past were substantially correct in amount, the bases thereof were misunderstood. Heretofore the practice of the art of ventilation has been based on the theory that a certain amount of fresh air must be supplied to maintain the purity of air of the occupied apartment. A certain proportion of carbon dioxide in the air has been used as a basis in determining the standard of ventilation, or the amount of air required for ventilating purposes. The permissible standards, or the limit of CO_2 in the air of the schoolroom, is stated by different authorities to be as follows:

Barry.........	6 parts in 10,000
Carpenter.....	8 parts in 10,000
Allen..........	7-10 parts in 10,000
Shaw..........	7 parts in 10,000
Bowler........	6-7 parts in 10,000

The generally accepted standard has provided that the air of the schoolroom shall not contain over seven to eight parts CO_2 in 10,000 parts of air. Using the formula

$$V = 10{,}000 \frac{N.\,6}{S-4}$$

to be supplied, 10,000 represents 10,000 parts of air, N the number of occupants, .6 the amount of carbon dioxide given off per person per hour in cubic feet, S the standard of purity to be maintained in the air of the room and 4 the number of parts of carbon dioxide ordinarily found in outdoor air, the amount of air required per person to maintain eight parts CO_2 in an occupied apartment is found to be 1,500 cubic feet of air

per hour per person, and to maintain seven parts CO_2 2,000 cubic feet of air per hour per person. In practice, and in accordance with all the laws covering the ventilating of school buildings, it has been customary to design school ventilating plants on the basis of 1,800 cubic feet of air per pupil per hour. In this connection the following authorities are quoted as to the number of cubic feet of air per hour required for schoolroom ventilation:

Barry	1800
Dresslar	2000-2500 according to grade
Morrison	2000-3000 according to grade
Carpenter	3000
Allen	2400
Woodbridge	2500
Rafter	850-2000 according to grade
Shaw	1800
Bowler	3000

While 1,800 cubic feet of air per pupil per hour, is the subject of general agreement in the matter of schoolroom ventilation, there are some school boards which, desiring the best possible atmospheric conditions in the schoolrooms, have placed the maximum CO_2 content of air of a schoolroom at six parts in 10,000 parts of air, or 3,000 cubic feet of air per hour per pupil. So far as it relates to healthful atmospheric conditions there can be no objection to such a standard, but it is not believed that such an air volume is essential to proper ventilation if all other requisites are properly considered.

Carbon dioxide is no longer regarded as harmful. It may, however, be taken as a good index or measure of the air supply and diffusion.

Until recently the standard for temperature within the schoolroom was 70 degrees. Within the last two to four years 68 degrees has been generally adopted as the most desirable schoolroom temperature, and there seems to be complete agreement that the temperature of the schoolrooms should not exceed this mark. Some efforts have been made to reduce this temperature to 65 degrees and even less, but it has not been demonstrated that such a low temperature is satisfactory. It is at least to be doubted whether it will be satisfactory unless a proper degree of humidity is maintained.

Until very recently such refinements as air filtration, air washing, temperature regulation, humidification and the general diffusion of air, were not regarded as essential details of a heating and ventilating plant, but all of these factors have now become recognized as of vast importance in ventilation work.

In the new conception of ventilation three things stand foremost. These are, Temperature, Humidity and Air Movement.

As stated above the temperature of the schoolroom should be 68 degrees.

In the matter of relative humidity there is no such agreement as to the necessity of providing for artificial humidification, nor is there an agreed standard of relative humidity.

The following authorities are quoted as to the desirable percentage of relative humidity which should be maintained in occupied apartments:

Wolpert	40%-60%	Rubner	30%-60%
Oesperlen	40%-60%	Riepzchel	30%-40%
Scherer	30%-60%	Richardson	40%-60%
Paul	40%-60%	Shepherd	30%-55%
Rietschel	40%-60%	Brefflar	40%-50%
Smith	50%-60%		

There exists in the above a general agreement that the relative humidity should not be less than 30 per cent nor more than 60 per cent. The prevailing opinion is that the minimum should be 35 per cent and that it is not necessary to provide artificial humidification in excess of 45 per cent to 50 per cent.

In extremely cold weather a relative humidity in excess of 35 per cent will cause a freezing on the windows. While there is no element of harm in this it has led engineers to so design the artificial humidification system that 35 per cent should be the maximum in extreme cold weather.

It has been stated that the dry air produces adenoids and a thickening of the mucous membrane of the respiratory passages which, long continued, results in hypertrophy thereof, and conditions which make infection easily possible. Also that it produces restlessness and nervousness and results in inattention and lassitude.

A higher degree of relative humidity is said to produce quiet and restfulness, permitting a greater degree of concentration and effort.

Debated as these views are the consensus of opinion favors such artificial humidification as will prevent a relative humidity of less than 35 per cent in occupied apartments and the best school heating and ventilating systems designed today provide for means of artificial humidification, as will be explained.

It may not be questioned that the degree of relative humidity has a decided effect on the feeling of comfort at a given temperature. A high temperature is necessary for comfort if the air is dry. This is so because the hot, dry air absorbs a great deal of heat from the body in the evaporation of moisture from the surface thereof because of the capacity of hot, dry air for moisture. With a higher relative humidity

the absorption of moisture, and consequently the absorption of heat, is lessened, and the room temperature may be lowered. The extent of this lowering of the temperature is variously stated to be from two to ten degrees. Conversely a very low temperature with high humidity produces a feeling of chill, because of the rapid absorption of heat from the body by the moisture in the air.

It has been erroneously stated that by the lowering of the temperature and the raising of the relative humidity a large saving in fuel could be made. The fact of the matter is that even should the temperature be lowered ten degrees the amount of heat required to produce 50 per cent relative humidity in zero weather would require the use of four times as much heat and fuel as would be saved by the ten degree reduction in room temperature. Incidentally, approximatey one to one and one-half horse power of additional boiler capacity is required for the artificial humidification of each standard classroom.

Artificial humidification of school buildings has met with pronounced favor wherever tried.

The problem of temperature and humidity, as will be seen from the above, are closely interwoven. With these is also linked the third, and possibly the most important element of artificial ventilation as it is viewed at this time, that of air movement required for the removal of the heat and moisture given off by the body.

The heat given off by the body of an adult at rest is variously stated by authorities as follows:

Pettenkofer	400 Heat Units per hour
Benedict and Milner....	375 Heat Units per hour
Rubner	380 Heat Units per hour
Landois and Roseman...	368 Heat Units per hour
Atwater and Benedict...	366 Heat Units per hour
Fluegge	495 Heat Units per hour
Wolpert	400 Heat Units per hour

As will be noted the average is approximately 400 heat units per person per hour. The amount varies with the size of the body, degree of activity, food consumed and dress. For a grade school pupil the heat given off amounts to about 300 Heat Units per hour.

The moisture elimination from the human body at rest is stated by Thomas to be one-twelfth of a pound per hour, and by Milner and Benedict to be one-fourteenth to one-twelfth of a pound per hour.

This combination of heat and moisture, remaining and accumulating in the air immediately surrounding the body, produces a hot aerial envelope and brings about identically the same uncomfortable conditions as exist in a room of high temperature and humidity without ventilation. Hence it becomes vastly important that there should be such a movement of air surrounding the body as will remove this film of hot, moist air.

Much has been said of the rising column of air surrounding the body with the inference that this column of rising air, induced by the heat and moisture of the body, causes an upward current of air which, if not sufficient to bring about ventilation, at least assists upward ventilation. The fact of the matter is that it does not do this. It is stated by Shaw that this upward movement of the air surrounding the body is equal to one and one-half to two feet per second. In any case it is so slight as not to be considered a factor in the problem of ventilation or in the determination of the system of ventilation, or the direction of air movement therein. Such movement of air is upset by the least air current due to the operation of any ventilating system or other causes circulating the air within the room. Also, it is more than offset by the cooling effect of windows, walls, doors and roofs.

In the case of a standard classroom the heat given off by the pupils is equal to fifty to eighty square feet of direct steam radiator surface. Manifestly the schoolroom must be provided with sufficient heat to produce the desired temperature at the time of its occupancy. This amount of additional heat from the pupil must be carried off continually. The removal of this heat increment can best be accomplished thru the medium of air, exhausted from the room, which is replaced by a constant supply of fresh air at a temperature which will permit of the taking up of this heat without the over-heating of the room.

It has been found difficult to introduce air into an occupied room at a temperature of more than ten degrees less than the room temperature without causing annoying draughts. Three hundred heat units, which, as stated above, are given off per pupil will heat approximately thirty cubic feet of air thru a range of ten degrees. Therefore it is that thirty cubic feet of air per pupil per minute is determined upon as the amount required for ventilating purposes in schoolrooms. This new basis of determining the volume of air required for ventilation is the only logical one, and is recommended by Rietschel, Winslow, Franklin and others. Experience has thoroly demonstrated that this volume of air, properly introduced and diffused thruout the occupied space of the room, will absorb and carry

off the heat and moisture given off by the occupants thereof and give satisfactory ventilation.

As evidence of the effect of a high temperature recent experiments conducted by the New York State Commission are of interest. Approximately 15 per cent less work was done by the subjects with a room temperature of 75 degrees than by the same students with a room temperature of 68 degrees. At 86 degrees the volume of work done fell 35 per cent. The same conditions relating to food, nature of work and other details were maintained during both tests. This statement relates to the amount of work voluntarily done rather than the amount which might be done under necessity.

The less importance now attached to the proportions of carbon dioxide and oxygen contained in the air, and the significance of air movement and high temperature may be illustrated by reference to experiments conducted by Dr. Leonard Hill. He observed three students confined in a small air-tight chamber. He says: "We have watched them trying to light a cigaret (to relieve the monotony of the experiment) and puzzled by their matches going out, borrowing others, only in vain. They had not sensed the percentage of diminution of oxygen, which fell below seventeen." As is well known the percentage of oxygen in the occupied apartment rarely falls below twenty. The temperature and humidity within the chamber became so excessive that the students became wilted and faint. The starting of electric fans within the chamber brought prompt relief. The breathing of outside air thru a tube brought no relief, while the breathing of air within the chamber by students without caused no discomfiture. The relief felt because of the operation of the fans would doubtless continue until the temperature and humidity rose much higher. This and many other similar experiments have demonstrated the importance of such air movement as will remove from the body the heat and moisture given off therefrom.

Experiments made by the New York State Commission on Ventilation to determine the relative effects of stagnant air and fresh air showed a distinct decrease of appetite in the stagnant air altho the subjects were apparently not otherwise affected. Whether this was due to the sub-conscious effect of odors or was indicative of other, and possibly more serious, effects has not yet been determined. This matter is being further studied.

As a result of two years of experimentation at the International Y. M. C. A. College the conclusion is reached that "The foul, dry air ordinarily found in gymnasiums greatly lessens the value of the exercise." It is quite conceivable that mental effort may be similarly affected.

The importance of the effect of dust in the air of a room is a much debated question. There are those who assert that dust is an irritant, causing serious disturbances in the respiratory tract, and that it is the bearer of germs which obtain entrance to the system thru irritations and abrasions caused by the dust. Still others assert that dust coming into contact with steam heated surfaces produces carbon monoxide and carbon dioxide thru the process of distillation and that the oxidization of this dust robs the air of oxygen. The general belief prevails that such dust as is found in the air of the schoolroom is not directly harmful and the theory of aerial infection is abandoned. At least it is not materially affected by ventilation. The investigations of Professors Winslow and Baskerville in the New York City schools demonstrated that the amount of bacteria existing in the schoolrooms was negligible. None, however, contend that the removal of dust is not highly desirable, for altho it involves no real ill it is certainly unclean and objectionable. It is quite probable that the cumulative effect of breathing dusty air is bad. Certainly this is so in the dusty trades.

Odors are not generally believed to have any physiological significance. Many persons, however, are affected thereby psychologically while with others there seems to be direct lessening of the appetite which may directly affect the capacity for work.

Much discussion has been applied to the question of the organic content of exhaled air. A great many experiments have been made to determine the merits of this question. It is now very generally agreed that there is no toxic matter or poison, sometimes referred to as "crowd poison," in the air of an occupied apartment.

Ozone is no longer advocated a substitute for, or as an auxiliary to, artificial ventilation, except, possibly in some of the industrial processes.

Trade and local poisons do not enter into the problem of school ventilation except to the extent that extreme care should be used in the location of the fresh air intake so that by no possibility should the air taken into the building for ventilation become contaminated by smoke, sewer gas, stable odors or any local or trade dusts or poisons.

Probably no question relating to school ventilation has been more discussed within the last three or four years than has that of open air

schoolrooms. The advocates thereof assert that artificial ventilation is a failure, and maintain that the open air schoolroom and window ventilation has proved a remarkable success. But has the matter been fully analyzed? Usually a small class is the subject of this experiment, the class being conducted by specially selected and enthusiastic teachers; the students are given short lesson periods, ample rest periods, sleep periods and exercise periods. They are given special medical attention. Their physical welfare and mode of living are more or less subject to the care of nurses, their homes are visited to see that the best possible conditions are provided therein for the children, they are provided with medicines and furnished with lunches of special quality. With all these helps it would be strange indeed if the physical and mental progress of these children were not remarkable. But is there any assurance therein that the progress made is due solely to fresh air, or that similar results could not be obtained in closed rooms properly ventilated?

Experiments recently made seem to indicate that the elimination of the special diet alone lessens the results obtained in the open air schoolrooms. What the results might be with the elimination of one or more of the other special features is not known. Whether similar results can be obtained in a closed room with a similar regime also is not known. It has been reliably stated that the introduction of all of these special open air schoolroom features, with the special clothing required by the pupils, applied to the entire school system of the City of New York, would involve an annual increased expenditure of approximately $3,000,000.

An investigation of this problem of open air schoolrooms is being planned. The scheme proposed provides for the use of six schoolrooms, each containing the same number of children of the same age, living under approximately the same home conditions; one room is to be a closed schoolroom with 68 degrees temperature and the usual closed school regime, a second room is to be a closed room with 68 degrees temperature with the open air school regime, another room is to be an open air room with the usual open air school regime, another room is to be an open air room with the standard closed schoolroom regime, another room is to be a closed room with 50 degrees temperature and the closed schoolroom regime, and the remaining room is to be a closed schoolroom with 50 degrees temperature and the open air schoolroom regime. The 50 degrees temperature in the last two rooms would be continued only as long as outside weather conditions would permit. It is believed that such an investigation will give a great deal of valuable information on this important subject of open air schoolrooms.

The extensive investigations of Professors Winslow and Baskerville on atmospheric conditions of the New York City Schools warrant the belief that no superiority was apparent in the case of the naturally ventilated schoolrooms within the City of New York. The best and worst results were found in the artificially ventilated schools, the operation of the ventilating plant proving an exact index to the capability of the janitor. Manifestly it should be easier to secure proper results by selecting one capable engineer to operate a well designated and well installed system than by placing dependence upon a large number of teachers who have many other duties to perform and who know little of either the importance or method of operating the windows or plant to secure the best room conditions. It is common knowledge that one may remain within a room while the temperature rises to 75 or 80 degrees without becoming aware of such a condition. This is exactly what happens when the control of the temperature and air supply is left to the teachers. Such a condition results in listlessness, inattention, sleepiness, dizziness and even nausea on the part of the pupils.

With the artificial ventilating system it is possible to maintain indefinitely any temperature, relative humidity, air volume and air movement desired within the schoolroom or to vary these as required. It is impossible to maintain such a condition in a schoolroom by the manual control of radiators and the use of windows.

The failure of a teacher to give attention to the regularity of temperature results in high and excessive temperature changes, because of the extreme difficulty, and even impossibility, of maintaining the air supply thru the windows without draughts on some of the pupils, or of providing an air supply thru the windows when their is no breeze outside, or of providing an air supply on the leeward side of the building. Manifestly a breeze can produce an air current thru the windows upon but one or two sides of the building. The rooms on the other two or three sides of the building must fail to receive the proper air supply.

An effort to ventilate the school by means of windows is most often sure to result in objectionable draughts in the rooms on one side of the building, with some stagnant areas in all of

the rooms, while on the other side of the building the only air received by the schoolrooms is that coming from other rooms, which results in uncomfortable conditions in these latter rooms. And what is to be said of the dust coming in thru the windows? And how may the humidity be regulated?

The suggestion is often made that the windows should be opened at the top and bottom so that the fresh air may come in at the bottom while the hot, foul air goes out at the top. Such a suggestion is absurd because a wind pressure sufficient to bring air in at the bottom also brings air in at the top. The absence of a breeze which is sufficient to bring air in at both bottom and top permits of only the slightest amount of air movement in thru the bottom and out of the top, the amount thereof being entirely insufficient for the ventilation of the schoolroom. The only merit of this scheme is to secure greater diffusion of the air entering thru the window.

The recirculation of the ventilating air of a building has recently received much attention. The experiments of Dr. McCurdy at the Springfield Y. M. C. A. and of Professor Bass of Minnesota have opened a wide field of investigation. In the former case the results obtained by the recirculation of air thru an air washer were quite as satisfactory as those obtained with outside fresh air. Indeed the air when recirculated thru the washer was freer of dust than outside air not washed, and to this extent was superior to the outside unwashed air. In Professor Bass's experiments he also obtained satisfactory results in schoolroom ventilation with recirculated air, even with reduced air volumes, when admitted to the room directly in front of each individual pupil. His results, however, were not as satisfactory as to the elimination of odors by means of the air washer as were Dr. McCurdy's, where strong gymnasium odors seemed to be satisfactorily eliminated by the air washer. In the Springfield experiments much larger air volumes were used than are customarily used in school buidings, and in the Minneapolis experiments the effort appears to have been limited to an attempt to equal conditions in a room ventilated in the usual manner. During the past year these experiments have been continued under the direction of, and with the support of the New York State Commission on Ventilation.

By recirculation a material saving is made in the cost of fuel otherwise required for heating the outdoor air. This is partially offset by the cost of water required for rehumidification. However, the study of recirculation has not been carried far enough to warrant a recommendation of recirculation in school building ventilation.

The subject of artificial cooling, as applied to school buildings, has received very little thought. A few artificial cooling plants have been successfully applied to hospitals, banks and residences and there is no reason why cooling should not be applied to school buildings where sessions are held during the warm weather. The most serious difficulty involved lies in the fact that such artificial cooling plants are very expensive to install and operate. The cooling plant may be installed in connection with an air washing system, but at a cost of approximately $300 to $600 per 1,000 cubic feet of air to be cooled. The volume of air used, however, may well be reduced by one-half of that required for winter ventilation. In the matter of operation the cost for cooling ten degrees is approximately the same as that of heating to 70 degrees in zero weather. This is largely due to the fact that to accomplish successful cooling it is necessary to de-humidify the air or else the moisture content, or relative humidity, will be so great as to result in an uncomfortable "clammy" feeling.

If, as now seems proven, a high room temperature produces discomfort and physiological disturbances in the body resulting in a lessened inclination to do physical and mental work, the question of artificial cooling assumes a new importance.

Many methods have been used in the installation of ventilation equipment for school buildings. These may be generally classified as follows:

1. Natural ventilation. This term may be properly applied to only open air schoolrooms without artificial heat or ventilation; and to

2. Direct radiator systems, in which direct radiators are used for heating and dependence for ventilation is placed upon the use of windows.

3. Direct-indirect radiator systems, in which the air supply for the rooms is secured by means of small openings directly back of and under the radiators for the passage of air from the outside into the room thru the radiator.

4a. Gravity indirect system, without accelerated exhaust. In this system the air enters the building thru basement windows or other openings and passes over indirect radiators located at, or near, the base of flues connecting to the schoolrooms, the heating effect of the indirect radiators being depended upon to maintain the air supply to the schoolrooms. No pro-

vision is made to assure the exhaust of vitiated air in this system.

4b. Gravity indirect system, with accelerating radiators in the vent flues to assure the exhaust of the vitiated air.

Direct radiators are customarily, but not necessarily, used in connection with these gravity systems.

5a. Single fan systems, with no accelerating radiators in the vent flues.

5b. Single fan systems, with accelerating radiators in the vent flues.

In connection with these systems, direct radiators are customarily, but not necessarily, used.

6. Double fan systems, with no direct radiators in the classrooms.

7. Double fan systems, with direct radiators in the classrooms, often referred to as the "split system."

The direct-indirect method of air supply is most inefficient and unsatisfactory. Under the best weather conditions only, that is, with the wind blowing directly against the outside opening, will any air pass thru the opening and radiator into the room, and even then the air supply will be sufficient only for two pupils per radiator. Under other than the most favorable conditions no air is supplied by such a system. The increased size of the radiator necessary for the heating of the air results in over-heating the room during much of the time. This system may be combined with some form of an exhaust system to remove the heated and vitiated air, but the efficiency of the exhaust system is seriously lessened because of the small air supply secured thru the direct-indirect radiators.

Natural ventilation has been discussed above. Gravity ventilation, often confused with natural ventilation, is seriously objectionable in that its operation depends wholly upon outside atmospheric conditions. It is customary to design such systems on an assumed difference of 40 degrees between the outdoor temperature and the desired room temperature; that is, if 68 degrees is desired in the schoolroom 28 degrees is assumed as the outside temperature. When the outside temperature is less than 28 degrees an increased volume of air is provided by the gravity ventilating system, but when the outside temperature is above 28 degrees less than the intended amount of air is delivered by the gravity ventilating system. Inasmuch as the outside temperature is above 28 degrees for the greater portion of the heating season the gravity ventilating system fails to maintain the supply of air at the intended standard much of the time. Because ventilation is most needed in mild weather, this becomes a serious defect.

Any system of ventilation which is without means of making positive the exhaust of vitiated air, that is, ventilating systems without either accelerating radiators in the vent flues or exhaust fans, are seriously deficient because the removal of exhaust of the vitiated air is not assured. Very often in such systems this exhaust of the vitiated air fails entirely; in any case it proves to be variable in amount, and sometimes back draughts of cold air down the vent flues into the classrooms become serious. The use of accelerating radiators in the vent flues is subject to the same objection as has been applied above to the gravity systems of ventilation. They are wholly dependent upon atmospheric conditions, are often troublesome, and the cost of exhausting the vitiated air by this means is from four to ten times as great as the cost of exhausting the same amount of air by means of motor driven exhaust fans, the exact ratio depending upon the prevailing cost of fuel and electric current. Because of the fact that the cost of the fuel used in making the steam condensed in the accelerating radiators cannot be separated from the fuel used in heating a building, the cost of operating the gravity exhaust system is not known to the school board and so passes unnoticed, while the less cost of the electric current used in operating motors driving the exhaust fans, is carefully scrutinized and often harshly criticized by the board.

Every heating and ventilating engineer will agree that the most efficient and economical method of supplying and exhausting the air required for school buildings is that of using fans for both the supply and exhaust of air used in ventilating. Whether the fans should be driven by steam engines, electric motors, gas engines, or water motors will depend entirely upon local conditions. The use of electric motors has the advantage of simplicity and ease of management, requires less skill and meets with the most favor.

The use of direct radiators in all portions of the school building, except in the classrooms, is practically universal. There is some difference of opinion as to the wisdom of the use of radiators in the classrooms, but this is now generally conceded as wise and is in general practice. Without radiators in the classrooms the air supplied for ventilating purposes must be heated to a temperature ranging from 100 to 130 degrees and this is regarded as most undesirable. Further, the best results in heating and

ventilating work are obtained when the heating and ventilating work of the plant are separate features thereof. The direct radiators provide for greater economy in operation, in that they serve the purpose of heating the building before the period of its occupancy, and they permit of the continued warming of the building after school hours for the use of the teachers or detained pupils. By some authorities the radiant heat from the radiators is regarded as beneficial but this is open to serious doubt.

Some designers install sufficient radiation in the rooms to maintain a temperature of 70 degrees in zero weather independent of the operation of the ventilating plant. This is seriously objectionable in that it places in the classroom too large heating units which cool off so slowly as to increase the temperature of the room after the radiator valves have been closed, and the large radiators heat up too slowly when steam is admitted. These large radiators also involve large concentrated heat areas which affect the nearby pupils and are otherwise objectionable. The best method provides for the use of only such an amount of direct radiation as will equalize or balance the heat losses thru the windows and exterior walls. This radiation should be divided into two or more small units distributed along the outside walls, preferably under the windows where they are most efficient in counteracting the cooling effect of the windows and outside walls, and where they are less likely to interfere with the use of the blackboards. It is desirable also that these radiators should be supported from the walls by means of brackets, with three inches between wall and radiator and five inches between the bottom of radiator and the floor. The radiator so located can be readily cleaned on all sides, as can the floor under the radiator.

The type of boilers to be used depends entirely upon the size of the building. Only the largest of buildings warrant the use of water tube boilers. Even in such cases the horizontal return fire tube boilers will be just as safe and economical and less expensive. Fire box boilers have many advantages for medium sized school buildings.

Cast iron sectional boilers, if of ample capacity, are satisfactory for small buildings. If combined with indirect blast coils special care must be exercised to see that the height from the water line in the boiler room to the bottom of the heating coils is not less than four feet.

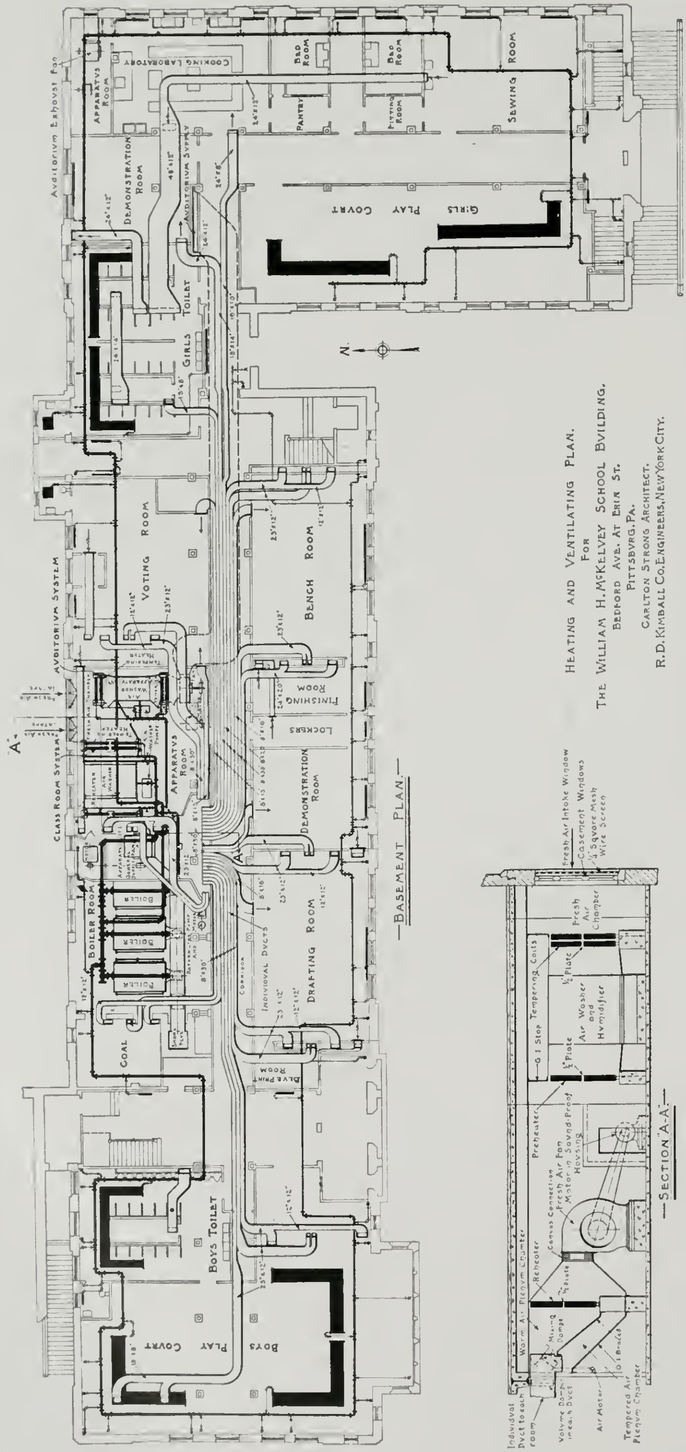
Fire box and cast iron sectional boilers are now made with double grates, the upper grate being a water grate and the lower grate of the usual type. These boilers are known as "down-draught" smokeless boilers, and are designed for the smokeless combustion of soft coal. They have proven very efficient, both in smoke prevention and in the economical use of fuel.

The general details of equipment and piping in school buiding heating and ventilating plants are very generally understood and will not be discussed here.

A separate system of steam piping should be installed for the direct radiators and for the indirect radiators or air heaters. This method will make possible the shutting off of all of the direct radiators in mild weather during the hours of occupancy.

The recent developments in vapor, atmospheric, modulating, and vacuum systems, as applied to school buildings, makes the use thereof highly desirable. By means of such systems the amount of steam admitted to each radiator can be moderated to meet exactly the demand for heat as influenced by the outdoor temperature. This overcomes the most serious objection to the steam heating system. Heretofore when the least heat was required, as in mild weather, the radiator valve was opened and the radiator was completely filled with steam, thus liberating into the room as much heat as would be required in zero weather. In these new systems only such an amount of steam is admitted to the radiator as is required to supply the heat necessary to maintain the desired temperature. These systems also have the further advantage of eliminating the use of air valves, which are a constant source of trouble.

The vapor systems are applicable to small buildings, but they require the use of radiators of very nearly the size required in hot water heating systems, while the atmospheric, modulating and vacuum systems require no larger radiators than do the old style gravity heating systems. These systems are applicable to buildings of all sizes. These systems all require special type of valves on the return end of the radiator and on the supply end of the radiator a special type of modulating or fractional steam admission valve is used. The increased cost of such systems is very slight (usually not over two to four per cent of the cost of the old style gravity systems). There are available many makes of valves applicable to such systems. The vacuum system involves the use of a vacuum pump, which is an inexpensive and simple device. In small buildings it may be operated by an electric motor. The saving of the cost of the


Heating and Ventilating Plan.
For
The William H. McKelvey School Building.
Bedford Ave. At Erin St.
Pittsburg, Pa.
Carlton Strong Architect.
R. D. Kimball Co., Engineers, New York City.
Basement Plan.
Section "A-A".
Girls Play Court
Sewing Room
Cooking Laboratory
Demonstration Room
Apparatus Room
Girls Toilet
Voting Room
Bench Room
Finishing Room
Lockers
Demonstration Room
Drafting Room
Blue Print Room
Boiler Room
Coal
Boys Toilet
Boys Play Court
Auditorium System
Class Room System
Auditorium Exhaust Fan
Corridor
Individual Ducts

air valves, with the further saving made possible by a reduction in the size of the return piping system and its insulation, will go far towards covering the extra cost of the modulating and vacuum valves.

If systems involving the use of air valves are used these air valves should be of the drip line type only, with drip lines to basement outlet.

The source of air intake for the building should be such that the air will be free of any contaminating odors and dust. If the point of intake is surrounded by a well grassed lawn, and especially if air washers are used, little objection can be made to taking the air in at the grade level, but it should never be taken in at grade level off a street or play-court. The taking of the air from the roof level is to be commended. Possibly the best practice is to take the air from a level midway between the ground and roof, but not less than twenty feet above the ground, as the air will often be found freer of dust at this level than at the roof.

If a gravity system of ventilation is to be used the usual type of cast iron indirect radiators will be found satisfactory. In connection with fan systems of air supply the pipe coils specially made for the purpose, or the cast iron vento radiation, may be used. The methods of applying these heaters are varied and depend upon the building conditions.

Many types of fans are available for supplying and exhausting the air to and from school buildings. The most generally used, and the most satisfactory, are the steel plate fans. These may be either of the "paddle-wheel" type or of the new Multiblade pattern, the latter having the advantage of occupying less space and being more efficient in the consumption of electric current. The disc pattern and cone type fans should rarely be used and only where the air velocities and resistances existing are very low, inasmuch as this type of fan is capable of overcoming but a very limited resistance. Only in the smallest of school buildings should they be used.

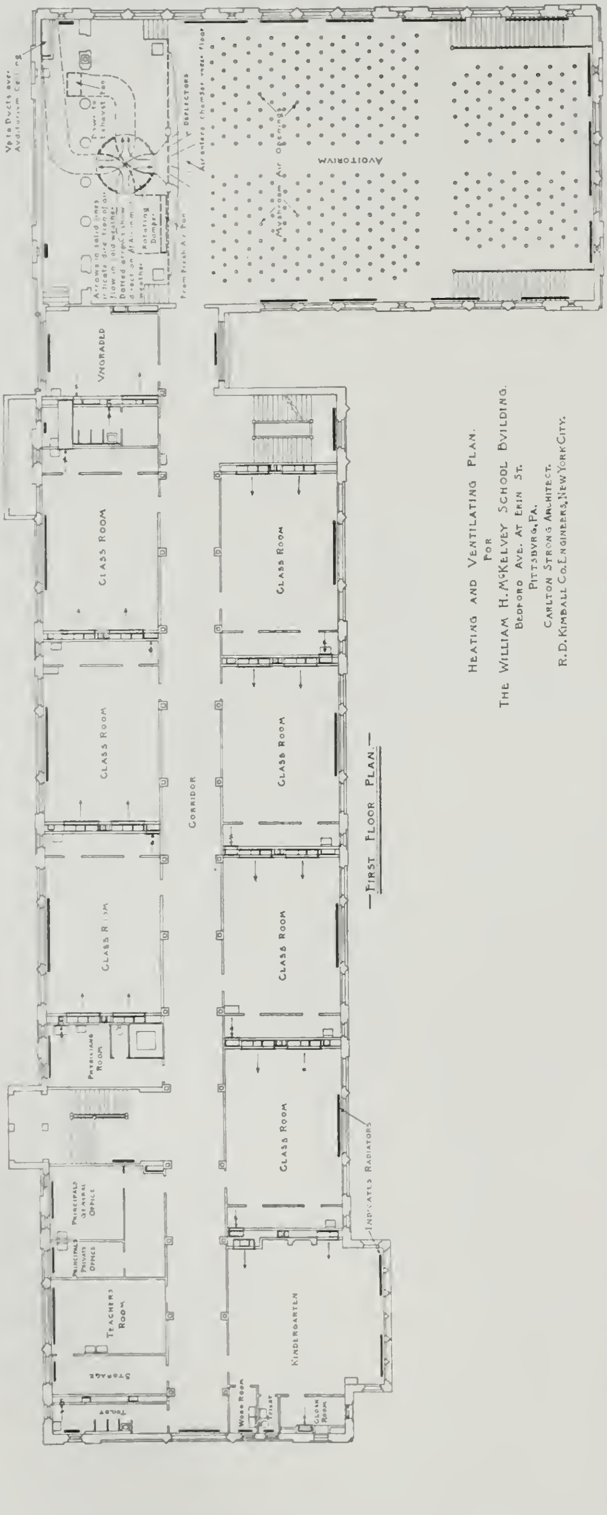
The installation of a number of small fan units is much preferable to the use of a less number of large fans. The installation and operation of the smaller units involve less complication in design and operation; a small system is always easier understood by the janitor, and a number of small plants rather than a single large plant will always be found a more flexible and satisfactory arrangement. Usually a sufficient saving in the cost of duct work is made to offset the slightly increased cost of a number of small units over the cost of a less number of large units. The use of small units permits of the distribution of same about the building in such a way as to involve less interference with the building construction and use of the basement.

The fresh air fans are generally placed in the basement, and the exhaust fans are usually placed in the attic space or in pent houses on the roof, altho they, too, may be placed in the basement.

Relatively few school ventilating plants include air washers, altho the proportion of new buildings which are so equipped is rapidly increasing. This is as it should be for the air washer has many advantages. It cleanses the air from dust and bacteria, making it cleaner than it can possibly otherwise be made and it makes possible the humidification of the air in the most efficient manner. The best types of air washers (those seven and nine feet long) make possible a limited amount of cooling in hot weather. Air washers are infinitely preferable to cloth screens of any type, inasmuch as they are much more efficient and more easily cared for. They are not complicated devices and are easily understood and operated by a janitor of ordinary intelligence. The cost of their installation adds but approximately ten per cent to the cost of the heating and ventilating installation in small school buildings and this increase in cost drops to five per cent in large school buildings. The cost of operation is very slight, as the same water is used over and over by means of a circulating pump for periods of one week to one month at a time, with only a slight amount of water added each day to make up for that evaporated; and the cost of electricity required to operate the motor driving the water circulating pump is small. The period of time during which the same water may be used over and over, depends upon the quality of the outside air.

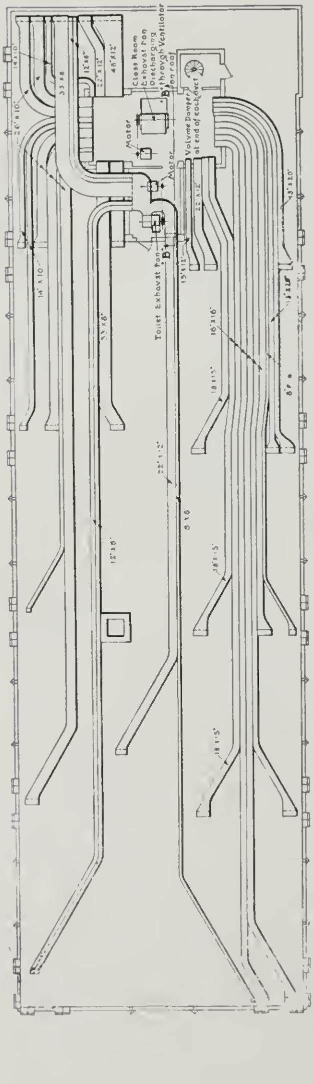
It is the author's opinion that the use of the air washer increases the efficiency of the ventilating plant by not less than twenty-five per cent. It is greatly to be regretted that a more general use is not made thereof. The desirability of clean, humidified air for the pupils in the schoolroom would seem to be so apparent as to demand the use of the air washers in every school building.

Another method of bringing about the artificial humidification of schoolrooms consists of an evaporating pan placed in the warm air chamber. This pan contains water in which is sub-



—First Floor Plan.—

Heating and Ventilating Plan.
For
The William H. McKelvey School Building.
Bedford Ave. at Erin St.
Pittsburg, Pa.
Carlton Strong Architect.
R. D. Kimball Co. Engineers, New York City.



—Attic Plan.—
—Showing Exhaust Ducts.—

Heating and Ventilating Plan.
For
The William H. McKelvey School Building.
Bedford Ave. at Erin St.
Pittsburg, Pa.
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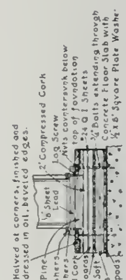
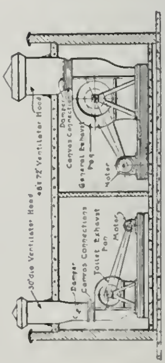
R. D. Kimball Co. Engineers, New York City.



—Foundations for Motors & Fans in Attic Space.—



—Section "B-B".—

merged a steam coil, the purpose of the latter being to evaporate the water, the vapor being liberated into the air passing thru the chamber to the schoolrooms. Attached to this tank is a float chamber automatically regulating the supply of water to replace that which is evaporated. The degree of humidification, in this case, as in the case of the air washer, is automatically controlled by means of a pneumatically operated humidostat, very similar in operation, to the thermostats used for temperature regulation.

The practice of producing artificial humidification by means of injecting steam directly into the air duct meets with very little favor, principally for the reason that in the majority of cases this method will produce an odor which is objectionable. The same objection applies to the method of spraying water on the steam air heaters, by which it is evaporated. The expense of artificial humidification is not affected by the method used.

In general, four methods are in use for distributing the air from the air heaters to the classrooms.

The first of these is incidental to the gravity system only, in which case the air goes directly from the indirect radiator into the base of the vertical flue leading to the classroom.

The second method is the single trunk duct system thru which the air is driven by the fan, this duct reducing in size as branches are taken off, with volume dampers placed at each branch connection or at the base of each flue. In the single trunk duct system mixing dampers cannot be used and this in itself is a serious objection to this system, there being available no method of varying the temperature of the air admitted to the room to meet the individual room requirements.

The third method is the double trunk duct system, in which an upper duct, of such a size as will carry the full amount of air required for ventilating the building, is paralleled with a duct directly beneath, of one-half to two-thirds the size of the upper duct. The upper duct carries air at the maximum temperature required for ventilating the rooms while the lower duct carries air at approximately twenty degrees less temperature. At the base of each heat flue, branches from both these ducts are joined together and at this point a mixing damper and a volume damper are installed. The mixing damper may be automatically or hand-controlled from the room, preferably automatically.

The fourth method is the individual duct system in which a separate duct is carried from the fan or plenum chamber directly to the base of the vertical flue which rises to the classroom. The plenum chamber is divided into upper and lower parts, the temperature of the air passing thru the upper chamber being slightly higher than that required for the ventilation of the rooms, and the temperature of the air in the lower chamber being approximately twenty degrees less. Connections are made from both of these chambers to the individual ducts with mixing dampers in each connection automatically controlled by a thermostat located in the schoolroom. In addition volume dampers are installed in each duct to regulate the volume of air supplied to each room.

By reference to the accompanying illustration showing the basement plan of the Wm. H. McKelvey School, of Pittsburgh, the general arrangement of such a system will be observed. In this case the air is taken thru windows into a fresh air chamber from which it passes thru tempering heaters, air washer and reheaters into the double plenum chamber. From there it is forced by a motor driven fan into the ducts, with connections from the upper, or hot air chamber, and the lower, or tempered air chamber. An individual duct runs to the base of each vertical flue communicating with the classrooms. Every mixing damper and every volume damper is placed directly at the plenum chamber, making for ease of adjustment and manipulation and assuring better attention on the part of the janitor. Such an arrangement is certainly more intelligible to the janitor.

The chief advantage of this system, however, lies in the fact that exactly the required volume of air at the exact temperature demanded by any and every individual room may be had, as required.

Manifestly a building has four sides. One or two sides may be subjected to the warming effect of the sun while the other sides of the building may be subjected to a severe cold wind. Under such conditions the rooms subjected to the cold wind and shade may require their air supply at a temperature as much as ten degrees higher than the room on the warm, sunny side. This demand is adequately met only by the individual duct system and it cannot be met by the trunk duct system in which air of the same temperature is supplied to every room. The direct radiators in the room cannot be properly depended upon to overcome this difference in temperature requirements for the reason that in the sunny rooms it may become necessary to admit the air into the classrooms at less than room

temperature to prevent an excess temperature, while on the other side of the building the air must be admitted at several degrees above the room temperature in order to maintain the temperature desired. It may be claimed that the direct radiators should maintain the balance in heat requirements but this has not proven satisfactory in practice. It interferes with the separation of the heating and ventilating elements of the system. This is especially so in that the direct radiators should not be used during the school hours in mild weather and at such times the temperature of the room should be controlled by the regulation of the temperature of the air supply.

The installation of the individual duct system increases the cost of the ventilating system by two and one-half per cent in large buildings and five per cent in small buildings, but, inasmuch as results obtained are decidedly superior to those obtained in any other system by making it possible to meet every varied demand in the different rooms it is certainly well worth its cost. This system has little or no effect on the operating cost of the plant.

Many of the same results as credited to the individual duct system can be obtained by the use of the double duct system but at a very slight difference in cost of installation and with the serious objection that it involves a complicated system of duct work with mixing and volume dampers scattered all over the building. In many cases these dampers are necessarily placed in inaccessible positions; thus they are hard to get at and their location is often forgotten and more often neglected. For these reasons the system is much more difficult to maintain in an efficient condition and the results obtained are correspondingly less satisfactory.

Temperature controlling systems are very generally understood but they are unfortunately not as generally used as should be the case. The automatic temperature controlling system is too often regarded as a luxury when it should be regarded as a necessity. It not only results in fuel saving, equal to not less than ten per cent and possibly twenty per cent of the annual fuel bill, but more important still, it prevents excessive temperatures in the classrooms, which have been shown to produce injurious effects on the pupils. In this instance, as in other details, the welfare of the pupils should not be permitted to suffer for a saving of five to ten per cent on the cost of the heating and ventilating plant.

In some instances the temperature regulating system has been applied to the direct radiators only, or to the mixing dampers only, where both radiators and dampers are used. This is a serious mistake, for successful results in temperature regulation cannot be obtained where a part only of the heating elements are under automatic temperature regulation. In the case of such an omission one element of the heating and ventilating system is constantly working against, and upsetting the work of the other.

With the vapor, atmospheric, modulating and vacuum systems the use of the intermediate acting thermostat is most desirable because it regulates the supply of steam to the radiators and the movement of the mixing dampers in a graduated manner in accordance with the demands for heating. Thus, in mild weather but little steam is admitted to the radiator; and the position of the mixing damper is changed but slightly, with more steam being admitted to the radiator and a greater change in position of the mixing dampers occurring as the outside temperature becomes lower, the full quantity of steam being admitted to the radiator during extremely cold weather only. Such a method goes far toward eliminating the overheating of the room and the discomfiture of the pupils sitting near the radiator.

A great deal could be written concerning the location of the fresh air inlets and vitiated air exhaust openings in the schoolroom. This is the subject of a great deal of discussion but one general principle is thoroly agreed upon. The number and location of both fresh air and vent openings should be such as to secure a thoro diffusion of the air thru every portion of the classroom. It has been demonstrated that such results can be obtained with the usual practice of one or two fresh air openings on one side of the room eight feet above the floor with a single exhaust opening on the same side of the room at the floor. The air openings into the room should, as far as possible, be directed towards the windows or the openings should be located in one of the end walls as near as possible to the windows with the exhaust opening at the other end of the same wall near the floor.

Much has been written regarding the desirability of admitting the air thru or near the floor and exhausting it near the ceiling, but this has not been satisfactorily worked out as yet. Professor Bass has made extensive experiments in admitting the air directly in front of the face of the pupil and exhausting it at the ceiling while reducing the volume of air. This plan fails in the air bathing of the body in general. A further criticism of this experiment lies in

COST DATA ON SCHOOL BUILDINGS

BUILDING	DATE	CUBITURE	SQ. FT. OF FLOOR AREA	NO. OF OCCUPANTS	COST OF BUILDING				COST OF HEAT. & VENT.				COST OF ELECT. SYST.				COST OF E. LIGHT. FIXT.				COST OF PLUMBING				COST OF VAC. CLEAN				COST OF ELEVATORS				PERCENTAGE CONTRACTS BEAR TO TOTAL COST OF BUILDING						
					TOTAL	per CU. FT.	per SQ. FT.	per OCC.	TOTAL	per CU. FT.	per SQ. FT.	per OCC.	TOTAL	per CU. FT.	per SQ. FT.	per OCC.	TOTAL	per CU. FT.	per SQ. FT.	per OCC.	TOTAL	per CU. FT.	per SQ. FT.	per OCC.	TOTAL	per CU. FT.	per SQ. FT.	per OCC.	TOTAL	per CU. FT.	per SQ. FT.	per OCC.	BLDG.	H & V	ELEC.	FIXT.	PLBG.	VAC. C.	ELEV.
WATT SCHOOL PITTSBURGH, PA.	1915	1,070,000	62530	700	$202,908	.189	3.24	289.85	$28,993	.027	463	41.42	$5,575	.005	.084	7.96	$				$10,400	.01	.166	14.86	$				$ —	—	—	—		14.3	28		5.1		—
WASHINGTON SCH. E. ORANGE, N.J.	1914	375,000		480	88,652	.237		184.70	10,400	.027		21.70	1,735	.004		3.61	1000	.0027		2.08	3,518	.009		7.33					—	—	—	—		11.7	1.9	1.1	3.9		—
WM. H. MCKELVEY PITTSBURGH, PA.	1915	1,055,265	53,460	700	227,254	.215	4.25	324.65	28,949	.027	.542	41.36	5,990	.006	.112	8.56					13,575	.013	.254	19.39					—	—	—	—		12.7	2.6		6.0		—
COS COB SCH. GREENWICH, CONN.	1915	491,759	27,260	554	78,500	.159	2.89	141.33					1,400	.002	.051	2.52													—	—	—	—			1.7				—
JAS. E. ROGERS PITTSBURGH, PA		1,197,000	56,675	700	233,613	.195	4.12	333.73	26,537	.022	.468	37.91	5,560	.005	.098	7.94					13,800	.012	.244	19.71										11.4	2.4		5.9		
WETHERSFIELD AVE. HARTFORD, CONN.		975,500	53,280	600	190,275	.195	3.57	317.00	29,850	.03	.56	49.75	6,842	.007	.128	11.40					12,214	.013	.229	3.69	1,328	.001	.025	2.21						15.7	3.6		6.4	.7	
GLADSTONE PITTSBURGH, PA		590,000	35,368	437	149,100	.253	4.21	341.1	14,960	.025	.423	34.23	3,370	.0057	.095	7.71					8,270	.014	.234	18.90					—	—	—	—		10.0	2.3		5.5		—
DILWORTH GRADE PITTSBURGH, PA		992,000	52,790	700	211,953	.214	4.01	302.80	22,673	.023	.43	32.39	5,135	.0052	.097	7.33					11,432	.012	.217	2.00					—	—	—	—		10.7	2.4		5.4		—
MONTCLAIR H.S. MONTCLAIR, N.J.		2,125,000	125,481	1500	424,010	.20	3.37	353.34	54,500	.026	.433	45.42	9,100	.004	.072	7.58					15,000	.007	.119	12.50					—	—	—	—		12.9	2.1		3.5		—
ELIZABETH H.S. ELIZABETH, N.J.	1915	1,662,700	102,556	1200	333,000	.20	3.25	277.50	34,949	.021	.341	29.13	8,822	.0053	.086	7.35					24,567	.014	.24	20.47					—	—	—	—		10.5	2.6		7.4		—
BRIDGEPORT H.S. BRIDGEPORT, CONN.	1915	2,016,000	117,633	1040	400,000	.198	3.40	384.60	41,000	.02	.349	39.42	6,680	.0033	.057	6.43					19,095	.009	.158	18.36					—	—	—	—		10.3	1.7		4.7		—
MERIDEN H.S. MERIDEN, CONN.		1,082,223		1150	165,141	.152		143.60	26,800	.024		23.30	7,780	.007		6.76	2,400	.0022		2.18	6,910	.006		6.00	1,151	.001	.021	1.00	—	—	—	—	72.8	16.2	4.7	1.4	4.2	.7	—
ALBANY H.S. ALBANY, N.Y.		2,114,400	140,400	1218	595,262	.28	4.22	487.08	67,156	.032	.481	55.14	33,460	.0158	.023	27.47	9,000	.0042	.062	7.38	27,775	.013	.197	22.80										11.3	5.6	4.2	4.7		
MT. VERNON H.S. MT. VERNON, N.Y.	1914	1,567,300		805	252,874	.185		314.12	32,091	.024		39.86	6,500	.0048		8.07					14,500	.0106		18.01										12.7	2.4		5.7		
SOUTH SIDE H.S. NEWARK, N.J.	1913	1,800,000	100,600	1200	336,000	.186	3.34	280.00	53,000	.029	.526	44.16	13,775	.0077	.137	11.48	3,825	.0021		3.18	12,000	.011		10.00	2,100	.002		1.75	—	—	—	—	75.08	15.5	4.1	1.1	3.6	.62	—
ST. LOUIS H.S. ST. LOUIS, MO.		3,762,000	183,500	2500	666,000	.177	3.63	266.40	136,281	.036	.743	54.52	21,800	.0058	.119	8.72					25,000	.0066	.136	10.00	4,850	.001	.026	1.94	2500	.0007	.015	1.00		20.5	3.2		3.7	.73	.37
GERMANTOWN [illegible] PHILAD. PA		5,345,000	214,000	3000	784,954	.146	3.66	261.70	97,527	.019	.456	32.51	30,000	.0056	.14	10.00					21,000	.0039	.098	7.00	1,600	.0003	.007	.53						12.3	3.6		2.7	.22	
SCHENLEY H.S. PITTSBURGH, PA.		4,500,000	265,300	1800	970,126	.216	3.66	538.90	150,863	.033	.569	83.81	35,900	.008	.135	19.94					42,263	.0094	.159	23.48					6,000	.0013	.022	3.33		15.5	3.7		4.4		.61
H.S. OF COMMERCE SPRINGFIELD, MASS.		3,195,000	195,000	1600	663,444	.208	3.40	414.60	92,744	.029	.476	57.96	25,517	.008	.131	15.95					32,000	.01	.164	20.00	1,700	.0005	.008	1.05						14.0	3.8		4.8	.125	
NEW BEDFORD H.S. NEW BEDFORD, MASS.		1,450,000	93,500	1200	481,222	.332	5.14	401.03	42,300	.029	.452	32.25	10,969	.0076	.117	9.14					34,753	.024	.372	28.96	3,200	.002	.034	2.60						8.8	2.2		7.2	.66	
H.S. OF PRACTICAL ARTS BOSTON, MASS.		1,222,900	68,250	1000	300,850	.246	4.41	300.85	23,390	.019	.343	23.39	22,346	.018	.327	22.35					14,926	.012	.219	14.93										7.8	7.4		5.0		
NATICK H.S. NATICK, MASS.		658,600	39,450	500	95,745	.145	2.43	191.50	14,490	.022	.367	28.98	2,250	.0034	.057	4.50					4,480	.0068	.114	8.96	900	.001	.023	1.80						15.1	2.4		4.7	.09	
SALEM H.S. SALEM, N.J.		352,464		367	60,520	.171		161.00	7,900	.022		21.52	986	.002		2.70					2,109	.005		5.75					—	—	—	—		13.2	1.0		3.5		—
[illegible] SCHOOL FRANKLIN, N.J.		443,858		450	58,797	.132		130.66	6,872	.015		15.27	1,247	.002		2.77					2,496	.005		5.54					—	—	—	—		11.5	2.1		4.2		—
MARBLEHEAD H.S. MARBLEHEAD, MASS.		583,600	36,850	300	107,013	.183	2.90	356.70	12,784	.022	.347	42.61	5,311	.009	.144	17.70					7,100	.012	.193	23.67										11.9	5.0		6.0		
HARTFORD H.S. HARTFORD, CONN.		1,888,000	89,880	1000	419,082	.222	4.66	419.08	68,382	.036	.76	68.38	9,550	.005	.106	9.55					14,150	.0075	.157	14.15										16.3	2.3		3.4		
CENTRAL H.S. NEWARK, N.J.	1911	2,685,000		1400	571,000	.213		407.86	50,848	.019		36.32					3,200	.0012		2.28	22,222	.008		15.89	1,667	.001		1.78	—	—	—	—		8.9		.52	3.9	.29	—
EAST SIDE H.S. NEWARK, N.J.	1911	1,074,000		600	249,883	.232		416.47	31,738	.03		52.87	12,464	.012		20.77	2,691	.0025		4.48	12,783	.012		21.30	1,347	.001		2.24	—	—	—	—	75.58	12.7	5.0	1.08	5.1	.54	—
[illegible] NEWARK, N.J.	1912	1,148,000		560	247,077	.215		441.21	30,770	.027		54.94	5,200	.005		9.28	4,587	.004		8.19	7,843	.007		14.00	1,014	.001		1.81	—	—	—	—	79.74	12.7	2.1	1.84	3.2	.42	—
CLEVELAND NEWARK, N.J.	1912	1,164,000		1665	241,222	.207		144.88	27,840	.024		16.66	4,096	.004		2.46	1,880	.0016		1.13	6,990	.006		4.19	1,062	.001		.66	—	—	—	—	82.75	11.4	1.7	.78	2.9	.44	—
[illegible] NEWARK, N.J.	1911	682,600		770	115,556	.169		[illegible]	14,240	.021		18.62	2,297	.003		2.98	1,470	.0021		1.90	4,085	.006		5.30	948	.001		1.30	—	—	—	—	80.5	12.3	1.9	1.15	3.5	.85	—
[illegible] NEWARK, N.J.	1911	687,000		720	122,860	.178		170.64	13,400	.02		18.61	2,415	.004		3.35	1,590	.0023		2.20	6,250	.009		8.68	1,100	.002		1.52	—	—	—	—	77.97	12.1	2.0	1.43	5.0	.90	—
MONTGOMERY NEWARK, N.J.	1911	769,000		1035	140,973	.183		136.21	14,450	.018		14.00	2,623	.003		2.53	1,663	.0021		1.60	5,987	.008		5.79	1,000	.001		.90	—	—	—	—	83.51	10.3	.9	1.19	4.2	.71	—
LYONS AVE. NEWARK, N.J.	1911	542,700		630	105,543	.178		167.21	11,793	.02		18.72	2,598	.004		4.12	1,430	.0024		2.20	4,490	.008		7.11	1,164	.002		1.84	—	—	—	—	79.4	11.2	2.4	1.30	4.2	1.10	—
WEST SIDE NEWARK, N.J.	1911	670,000		765	115,092	.171		150.45	12,600	.019		16.40	2,690	.004		3.51	1,450	.0021		1.89	4,980	.007		6.51	969	.001		1.26	—	—	—	—	82.3	11.0	2.3	1.26	4.3	.84	—
[illegible]	1910	550,200		175	125,313	.228		156.64	14,592	.027		21.61	2,534	.005		3.75					5,018	.009		7.13					—	—	—	—		11.6	2.0		4.0		—

COST DATA ON HEATING AND VENTILATING SYSTEMS.

the fact that the results obtained were compared with the results obtained in another classroom ventilated in the ordinary manner, with satisfaction expressed because the results appeared to be practically the same in both rooms altho a reduced volume of air was supplied in the experimental room. It seems to the author that the results aimed at should be to determine how much better results might be obtained with the individual air openings and usual amount of air supplied as compared with the ordinary fresh air inlet and single exhaust.

Professors Winslow and Baskerville studied this problem of air diffusion in classrooms of the New York City schools and found therein satisfactory results with the standard methods of classroom air distribution.

The problem of air diffusion becomes much more serious in large rooms, and especially in auditoria. In the latter the general rule should prevail that no member of the audience should be further than thirty feet from a fresh air inlet and air exhaust, with special attention given to the spaces under the galleries. The application of such a rule would eliminate many of the complaints made regarding auditorium ventilation. Where the seats are permanently fixed the best results can be obtained by exhausting the air thru the floor by means of mushroom openings and supplying the air thru openings in the walls or in the ceiling. The reason for urging the exhaust of the air thru the floor, rather than the supply of air thru the floor, is that in order to prevent excess temperature in the room air must be admitted at ten to fifteen degrees less than room temperature. Air at such a low temperature cannot be admitted in the immediate vicinity of the person without producing a serious chilling effect. In warm weather, when the outside air is of a higher temperature and the immediate relief of heat is essential, it is desirable to reverse the direction of the air current so that the air may come up thru the floor, pass up over the body, and go out at the ceiling. Such a reversal of the ventilating system can easily be made by the use of a reversing damper, as illustrated on the first floor plan of the school building ventilating system shown herewith. By reference to this print it will be observed that the air for the auditorium leaves the fresh air fan and enters one side of the reversing damper, leaving in such direction as to pass to the space over the auditorium ceiling, thence down into the room thru openings in the ceiling. It leaves the room thru mushroom openings in the floor and passing thru ducts to the rotating damper at one side, leaving it at the other side, thence passing to the exhaust fan. In mild weather, when it is desired to reverse the direction of the air current the damper is changed in position 90 degrees and the air is then directed from the fresh air fan to the space under the floor from which it enters the auditorium thru the mushroom openings, passing upward over the people to the outlets in the ceiling, from which it is drawn by the ducts down to the rotating damper, entering one side thereof and leaving the other side to the exhaust fan. Practically no complication is involved in such a scheme and by its use all the advantages of the upward and downward system of ventilation may be had at will.

An extensive study of the space requirements for ventilation plants has been made, under the direction of the author, in connection with forty school buildings, with the result that it has been found that approximately one and one-quarter square feet of floor area is required in the boiler room per thousand cubic feet of contents of the building, with approximately the same allowance for fuel supply. The space required for the fresh air plant, that is, the fans, heaters, air washers, motors, etc., varies from one square foot to one and one-half square feet per thousand cubic feet of space in the building, while the space required for the exhaust air plant is approximately half of that required for the fresh air plant. The height of these spaces depends upon the size of the building and its apparatus, varying from seven to fourteen feet for the fan rooms and from twelve to twenty feet for the boiler rooms. Usually the floor of the boiler room must be from two to eight feet below the level of the floor of the fresh air heater rooms, unless vacuum heating systems are used.

The usual size of the fresh air and exhaust flues for each standard forty pupil classroom is found to be four square feet in area in both the fresh air and vent flue, altho a number of systems are designed with three square feet of fresh air and vent flue areas each. These areas are increased or decreased as the number of pupils per room is increased or decreased.

Similarly a study of the cost of the installation of heating and ventilating plants was made in the same schools. It was found that the prevailing custom of apportioning a certain percentage of the total cost of the building for the installation of the heating and ventilating plant is of no value as these percentage ratios vary more than one hundred per cent, even with similar classes of installations. For a given size of building the cost of the heating and ventilating system will be approximately the same whether the building is a monumental stone structure or

a plain wooden structure, but the percentage of cost of the system will be very different.

As a result of this study the following scheme of classification has been arrived at:

Class "A"—Plants providing for fire tube boilers, double fan systems, air washers and humidifiers, individual or double duct systems and modulating control of direct radiators and mixing dampers.

Class "B"—Same as Class "A" but using automatic stokers and water tube boilers instead of the fire tube boilers.

Class "C"—Same as Class "A" but eliminating the modulation control of radiators and dampers and using the single trunk ducts.

Class "D"—Same as Class "C", except that it eliminates the use of air washers and humidification systems.

Class "E"—All other systems.

Manifestly there are many combinations of equipment which render an exact determination of classification difficult, but in general this classification has proven satisfactory.

After a careful study of this method of classification and the figures on costs as thus obtained, it was found that the only satisfactory basis of determining the cost of the installation of the heating and ventilating plant was on the basis of the cubic feet of space in the building. The variation in costs within the different classes of systems is rarely over ten per cent from the average, the greatest variation occurring in Class "A." The resulting costs are as follows:

Class A, cost of plant per cu. ft. 2.7c to 3.3c—average 3.1c.

Class B, cost of plant per cu. ft. 3.3c to 3.8c—average 3.4c.

Class C, cost of plant per cu. ft. 2.2c to 2.5c—average 2.4c.

Class D, cost of plant per cu. ft. 2.2c to 2.3c—average 2¼c.

Class E, cost of plant per cu. ft. 1.9c to 2.2c—average 2.1c.

If classes D and E were but abandoned and a proper amount of skill were used in the design, installation and operation of the remaining classes, a sufficient appropriation being provided for the installation and operation of the ventilating plant, it is believed that little basis would be left for complaint as to the success of the artificial ventilating system.

Classes D and E are the result of a too limited appropriation, a demand for too large a building for the funds available, too much ornamentation, or too much equipment, or, in other words, an attempt to build a $100,000 building with a $75,000 appropriation, the greatest sacrifice being made in connection with the heating and ventilating plant. Better were a proper building, well equipped, even tho smaller.

The author is encouraged to believe that a more general appreciation of these facts and of the possibilities of the artificial ventilating system is now manifesting itself.

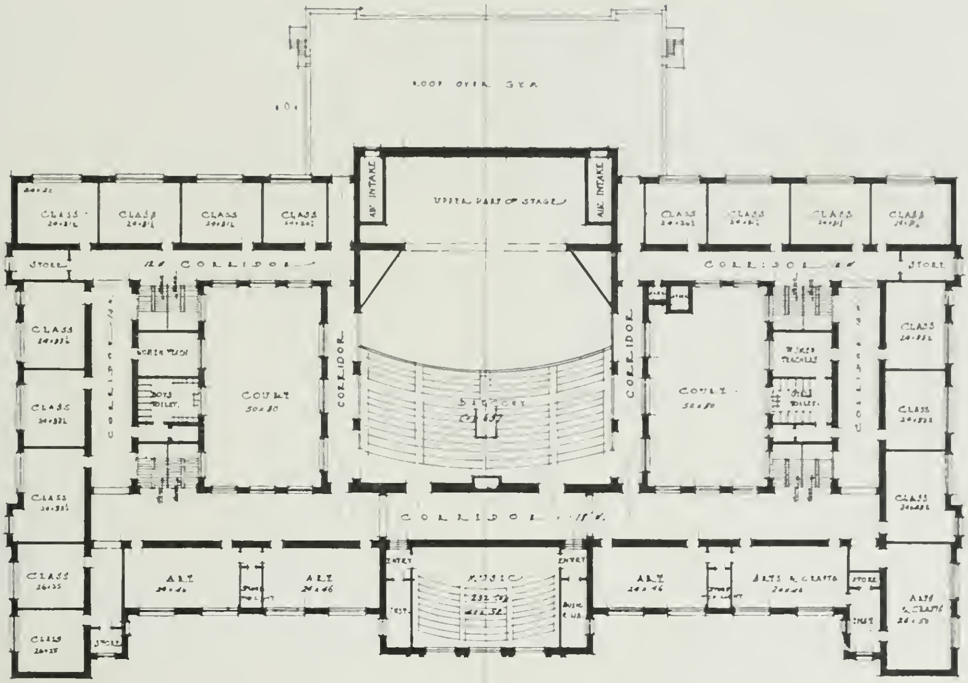
As a matter of information it is interesting to note that the cost of the plumbing equipment for school buildings ranges from three-quarters of a cent to one and one-half cents per cubic foot, the average being one and one-tenth cents. The cost of electric equipments, exclusive of electric power plants, ranges from one-half to one cent per cubic foot, the average being seven-tenths cents per cubic foot.

In the case of the heating and ventilating, plumbing and electrical work, the costs seem to be approximately the same in grade schools and high schools.

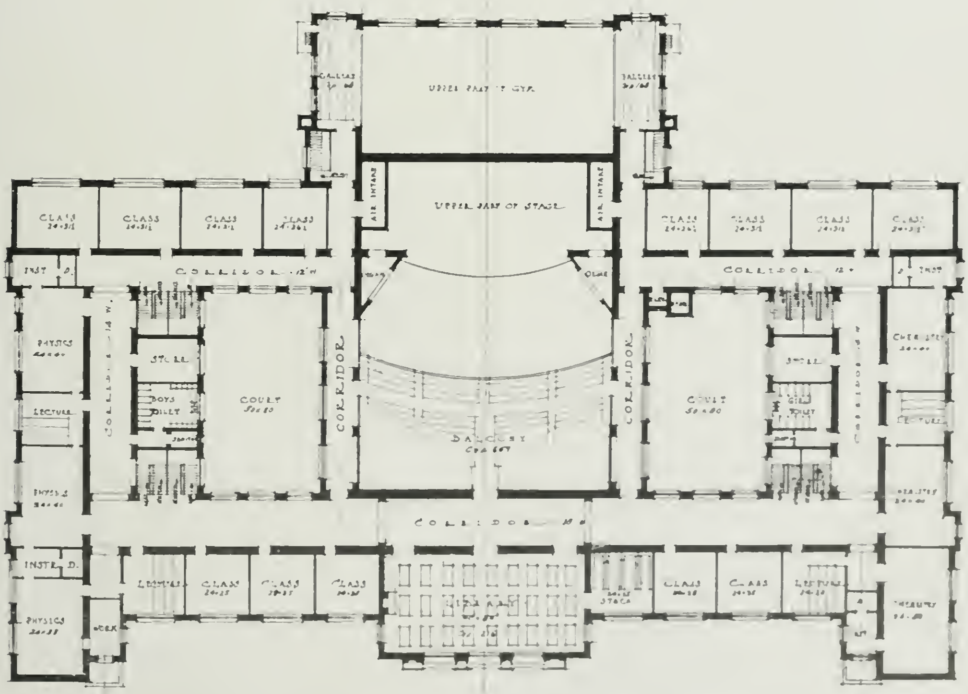
The appended table gives in detail the cost of various portions of a number of school buildings.

PLATES

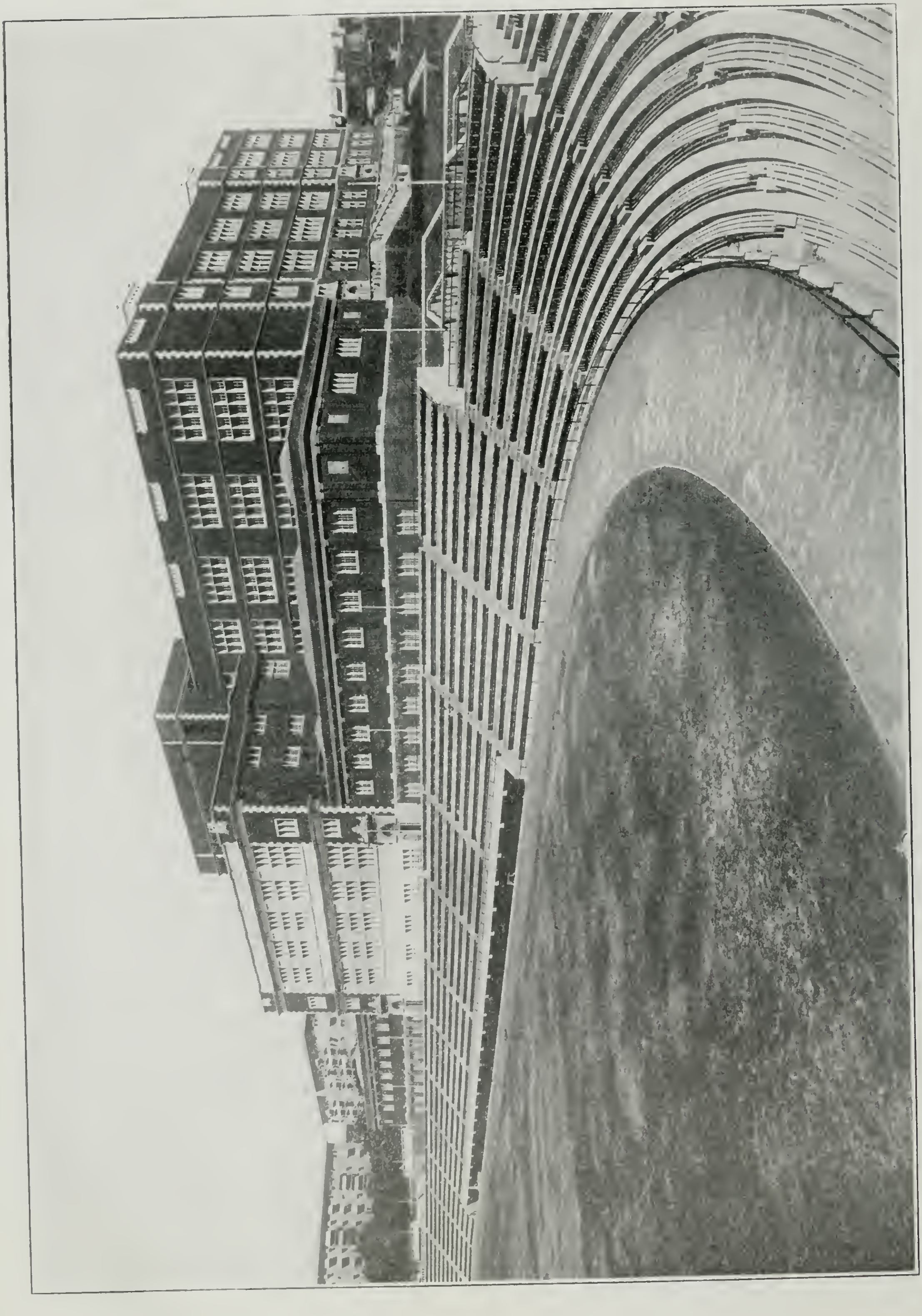
CENTRAL HIGH SCHOOL, WASHINGTON, D. C.
William B. Ittner, Architect, St. Louis, Mo.
Snowden Ashford, Municipal Architect, Washington.



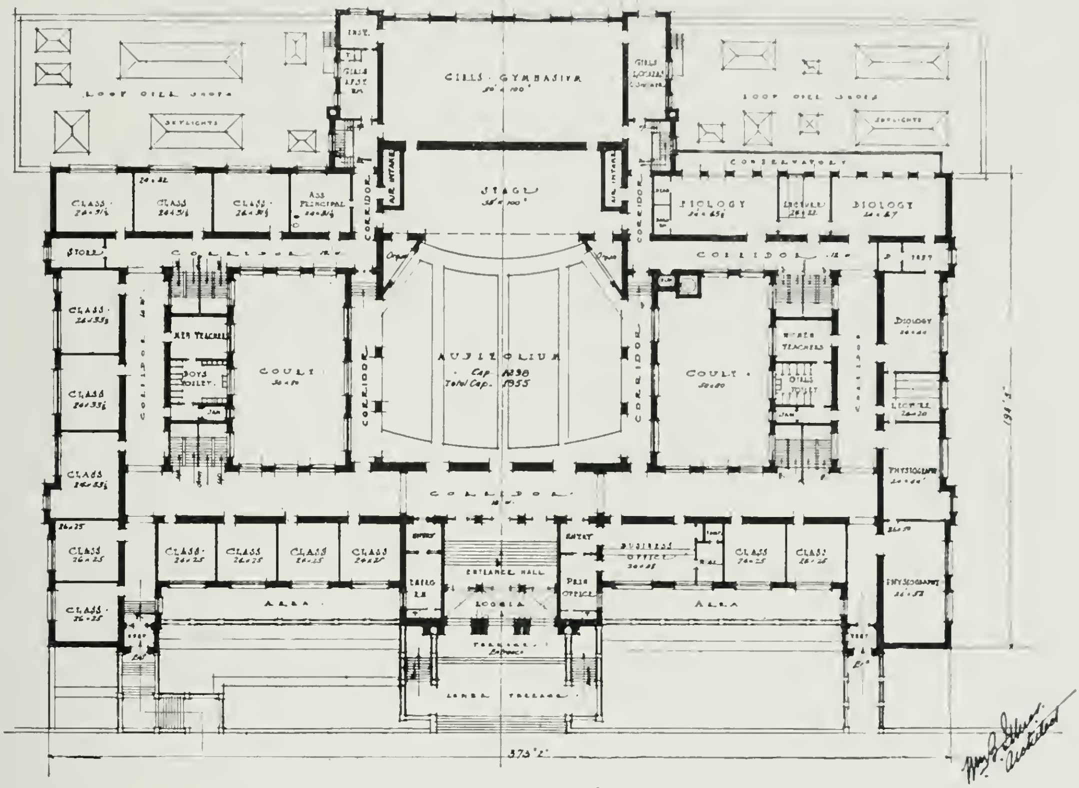
THIRD FLOOR PLAN, CENTRAL HIGH SCHOOL, WASHINGTON, D. C.



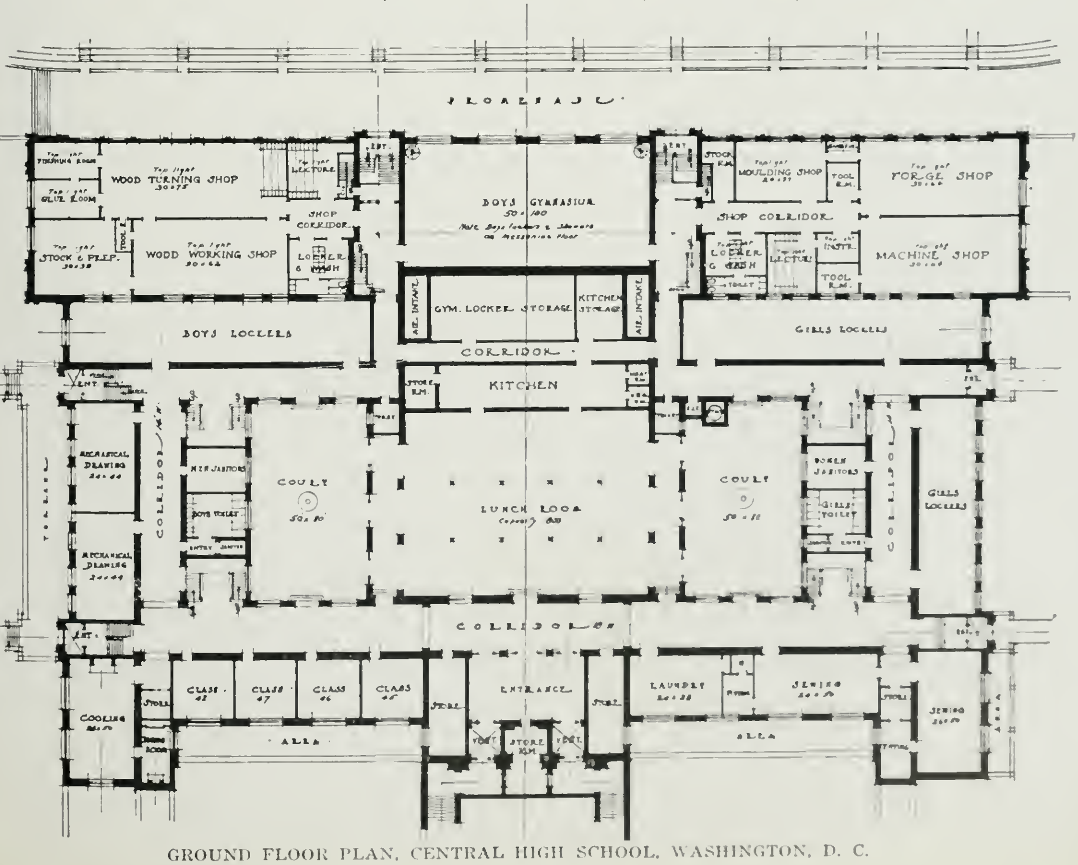
SECOND FLOOR PLAN, CENTRAL HIGH SCHOOL, WASHINGTON, D. C.



STADIUM FRONT, CENTRAL HIGH SCHOOL, WASHINGTON, D. C.
William B. Ittner, Architect, St. Louis, Mo.
Snowden Ashford, Municipal Architect, Washington, D. C.

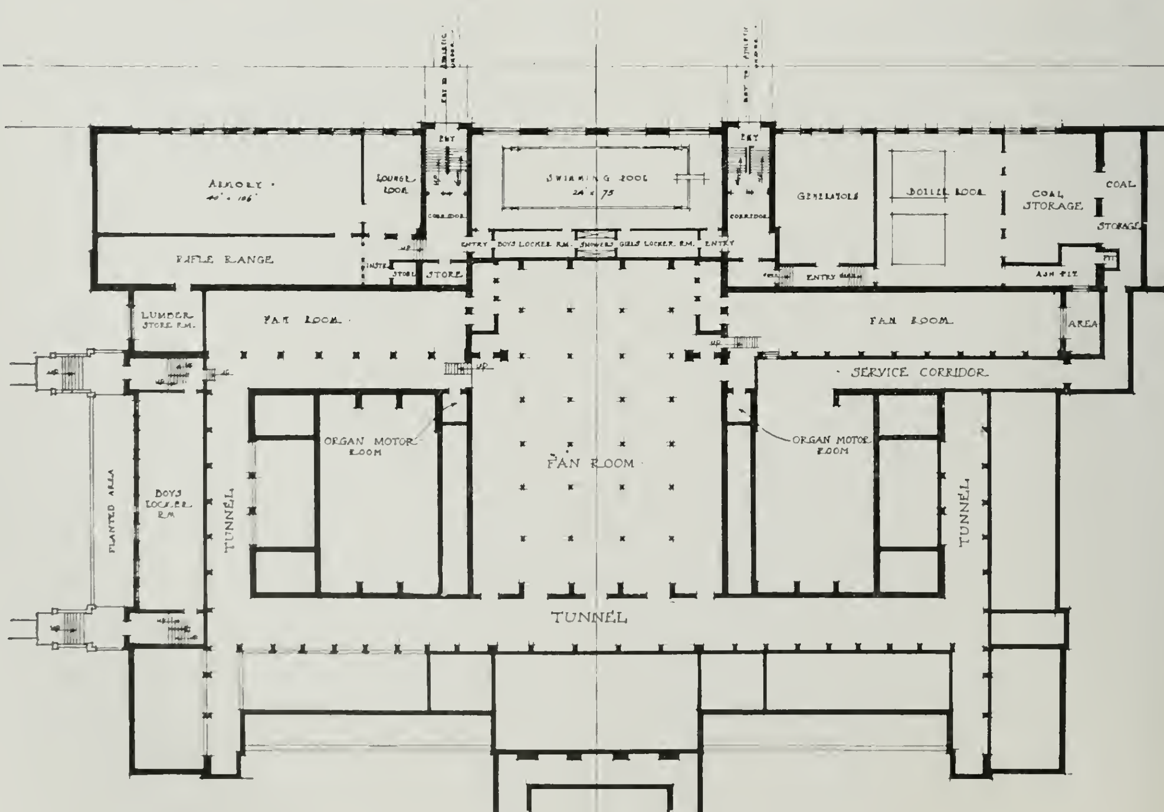


FIRST FLOOR PLAN, CENTRAL HIGH SCHOOL, WASHINGTON, D. C.



GROUND FLOOR PLAN, CENTRAL HIGH SCHOOL, WASHINGTON, D. C.

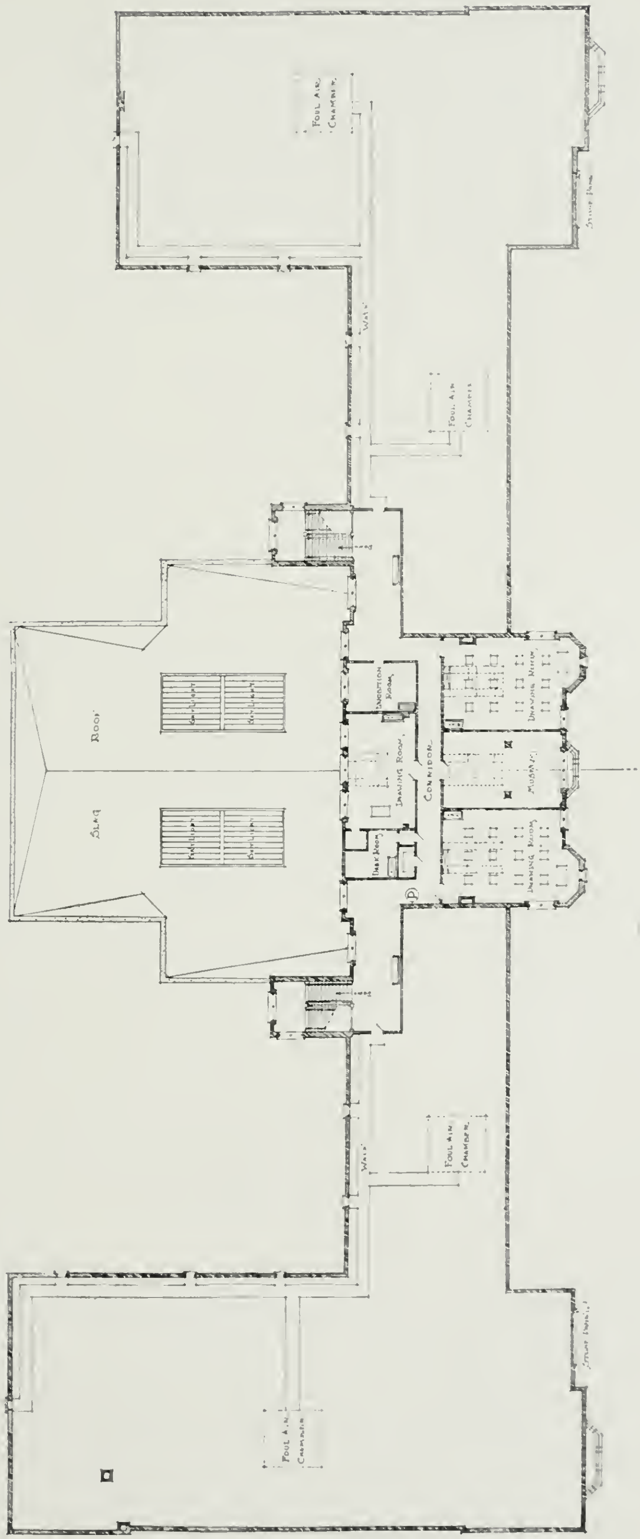
SIDE VIEW, CENTRAL HIGH SCHOOL, WASHINGTON, D. C.



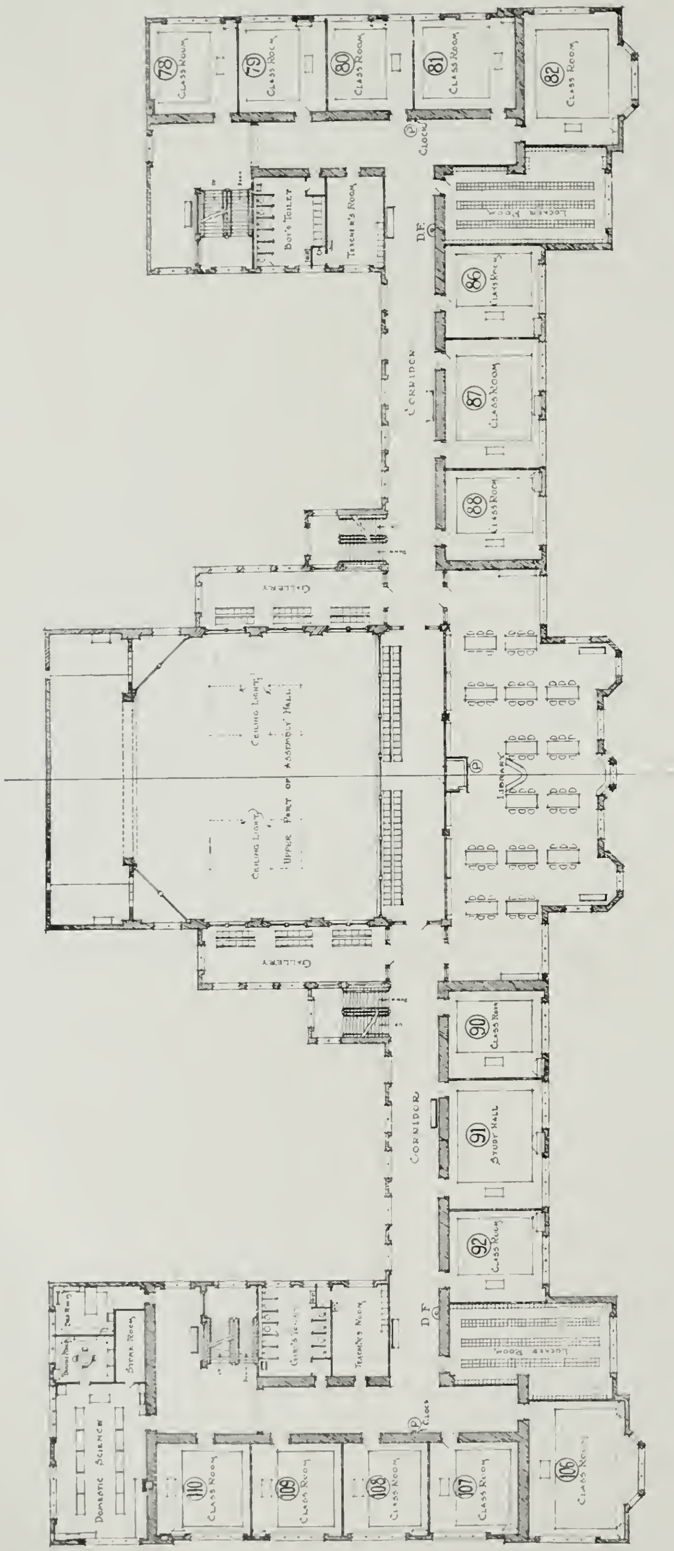
BASEMENT PLAN, CENTRAL HIGH SCHOOL, WASHINGTON, D. C.

DETAIL OF THE MAIN ENTRANCE, DUNBAR HIGH SCHOOL, WASHINGTON, D. C.
Snowden Ashford, Municipal Architect, Washington, D. C.

PAUL LAWRENCE DUNBAR HIGH SCHOOL, WASHINGTON, D. C.
Snowden Ashford, Municipal Architect, Washington, D. C.

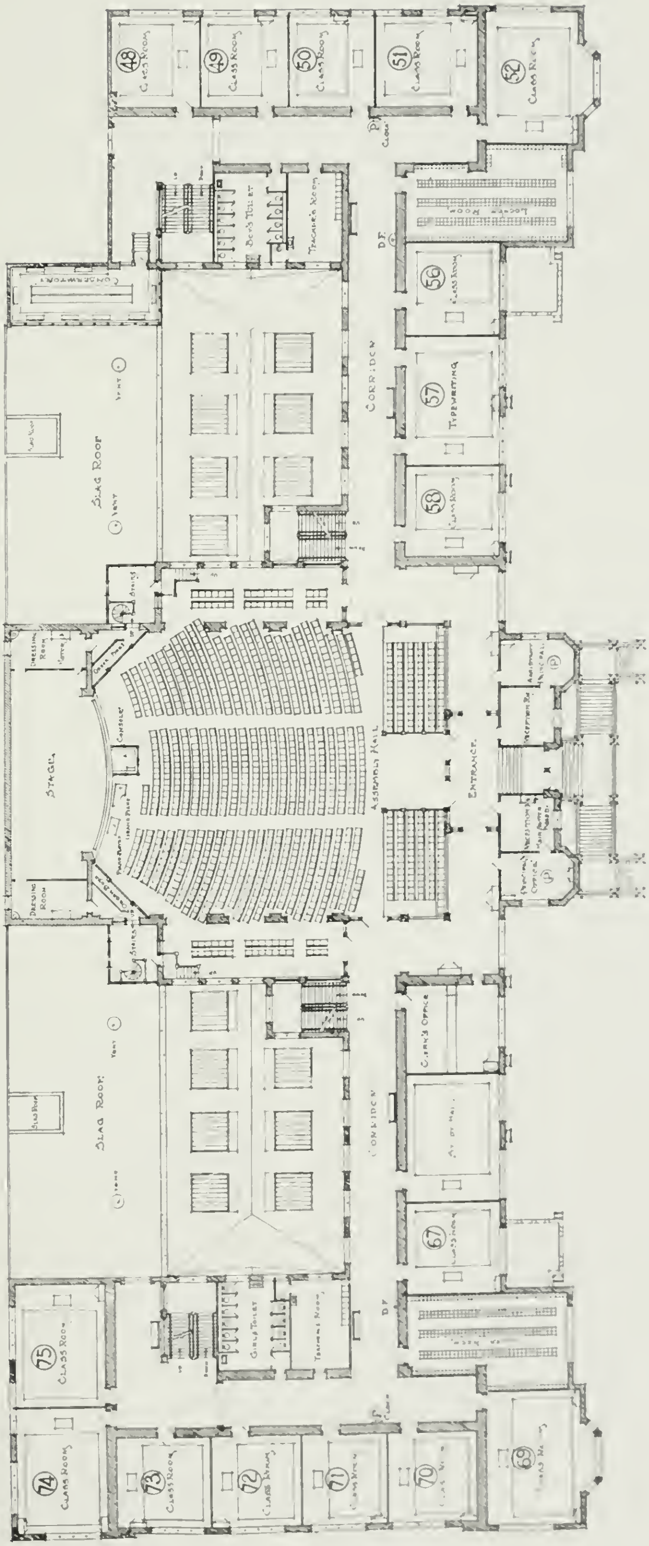


THIRD FLOOR PLAN, DUNBAR HIGH SCHOOL, WASHINGTON, D. C.

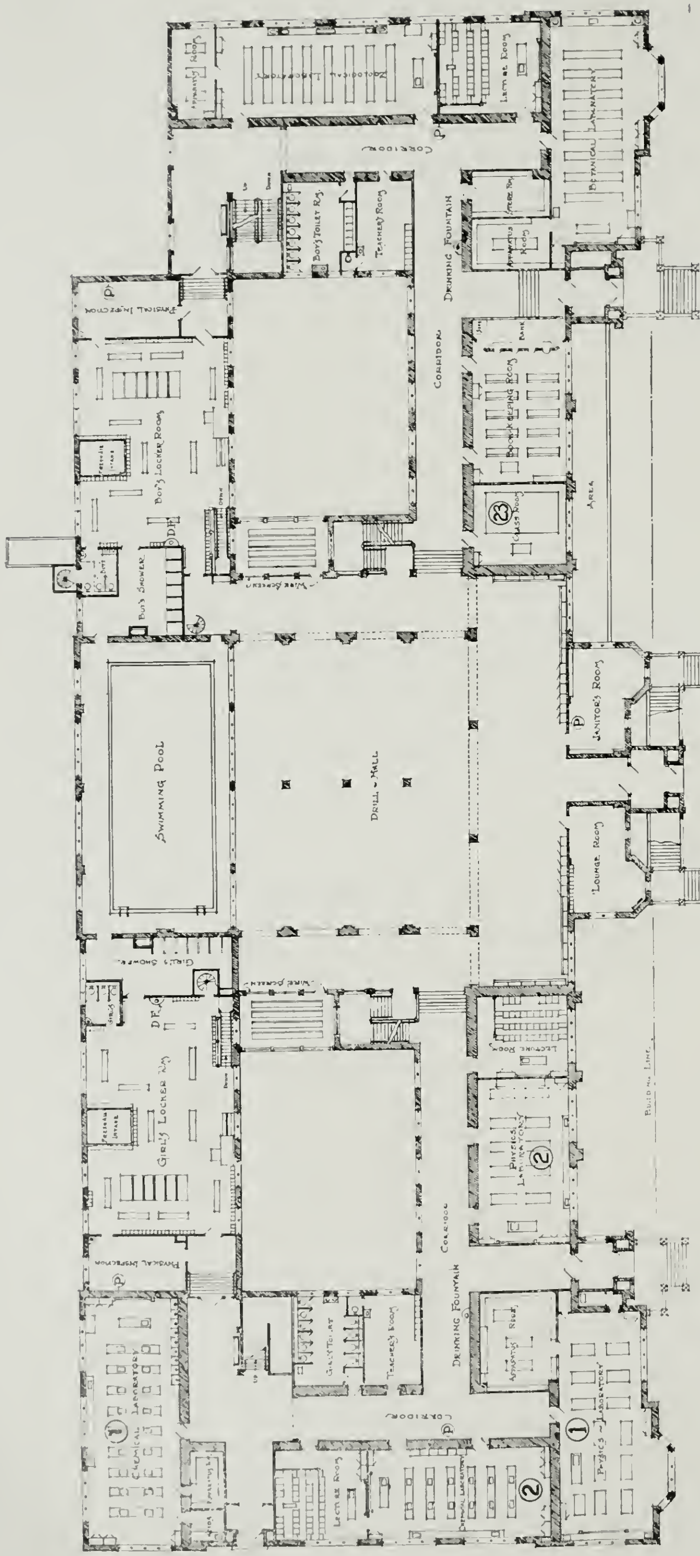


Second Floor Plan
Scale 1/16 inch = 1'0"

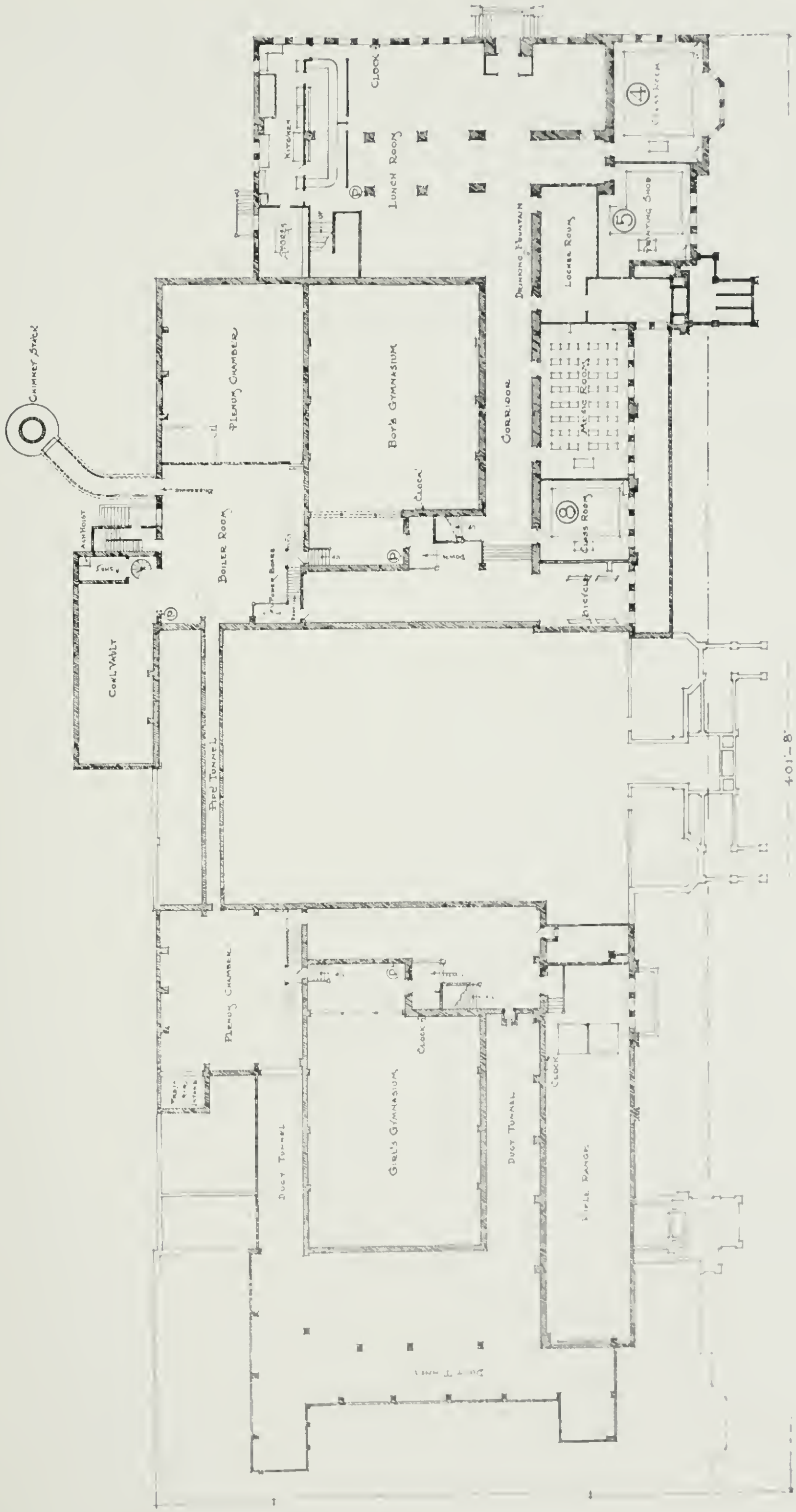
SECOND FLOOR PLAN, DUNBAR HIGH SCHOOL, WASHINGTON, D. C.



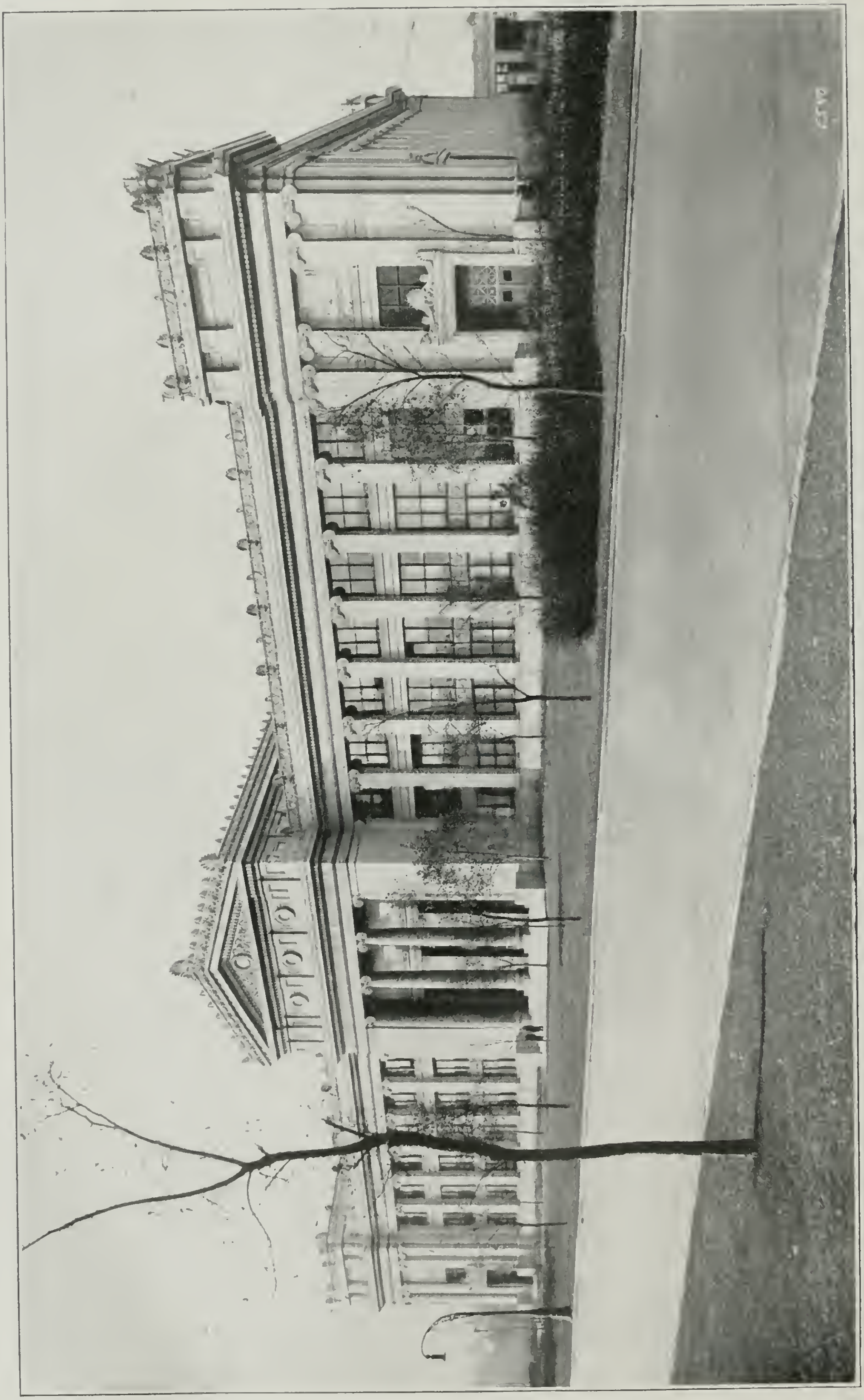
FIRST FLOOR PLAN, DUNBAR HIGH SCHOOL, WASHINGTON, D. C.



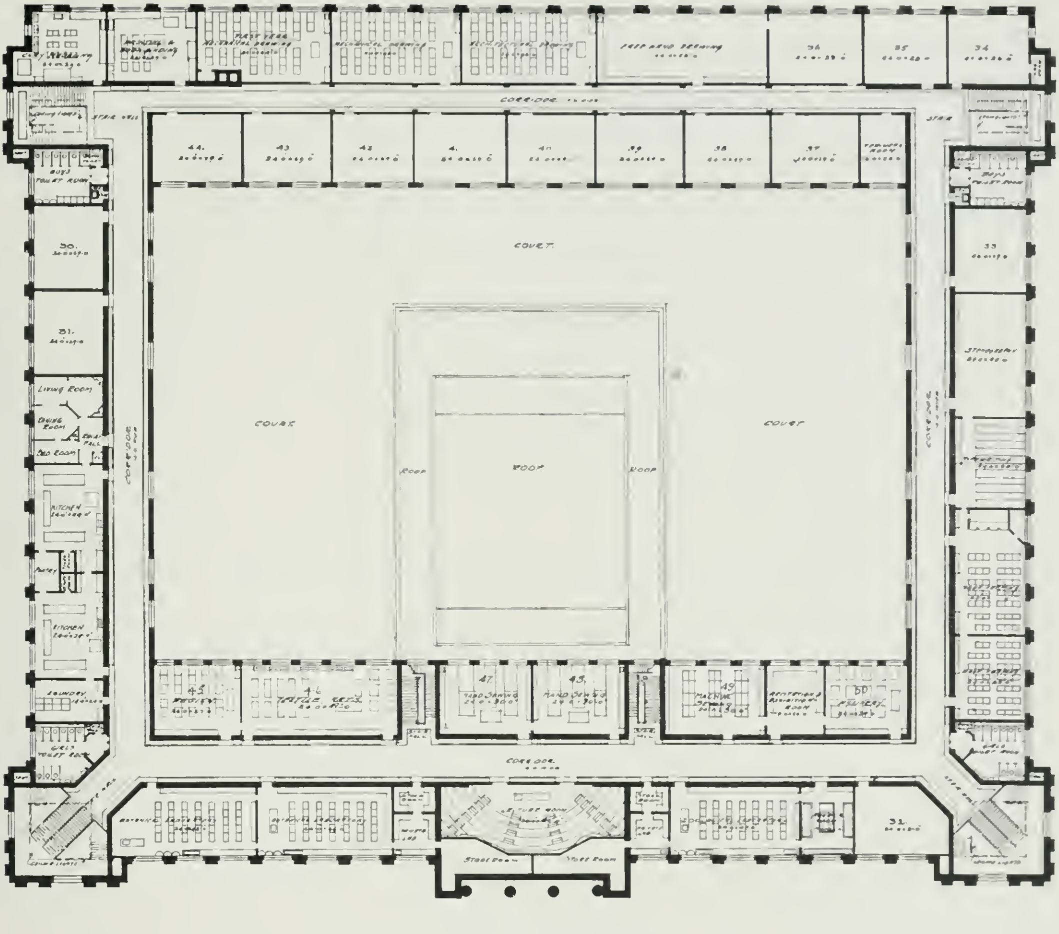
BASEMENT FLOOR PLAN, DUNBAR HIGH SCHOOL, WASHINGTON, D. C.



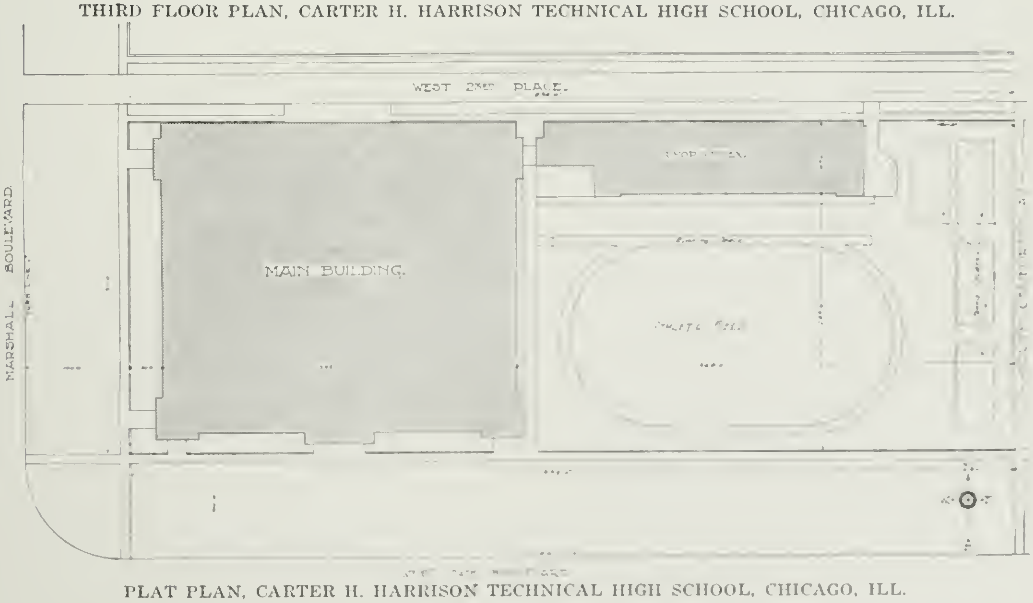
SUB-BASEMENT PLAN, DUNBAR HIGH SCHOOL, WASHINGTON, D. C.
Snowden Ashford, Municipal Architect, Washington, D. C.



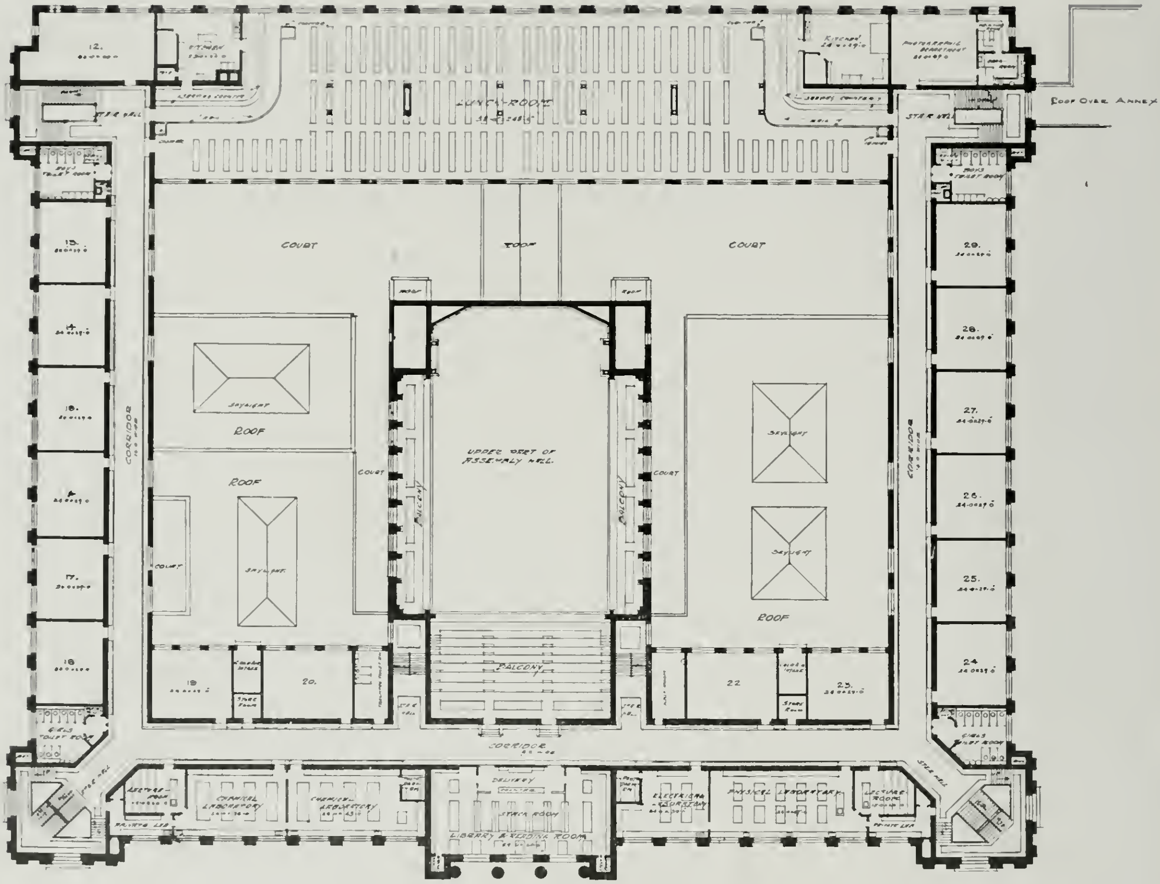
CARTER HARRISON TECHNICAL HIGH SCHOOL, CHICAGO, ILL.
Arthur F. Hussander, Architect of the Board of Education, Chicago.



THIRD FLOOR PLAN, CARTER H. HARRISON TECHNICAL HIGH SCHOOL, CHICAGO, ILL.

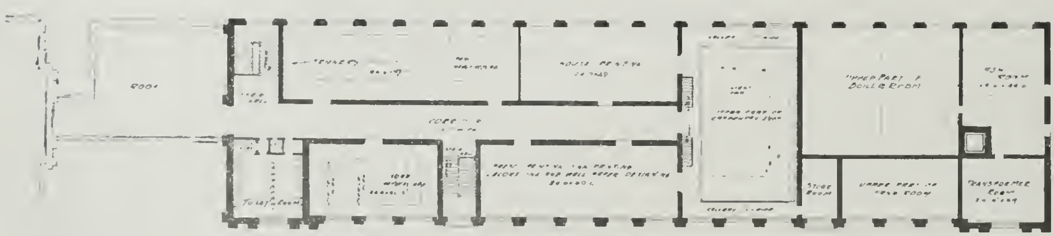


PLAT PLAN, CARTER H. HARRISON TECHNICAL HIGH SCHOOL, CHICAGO, ILL.



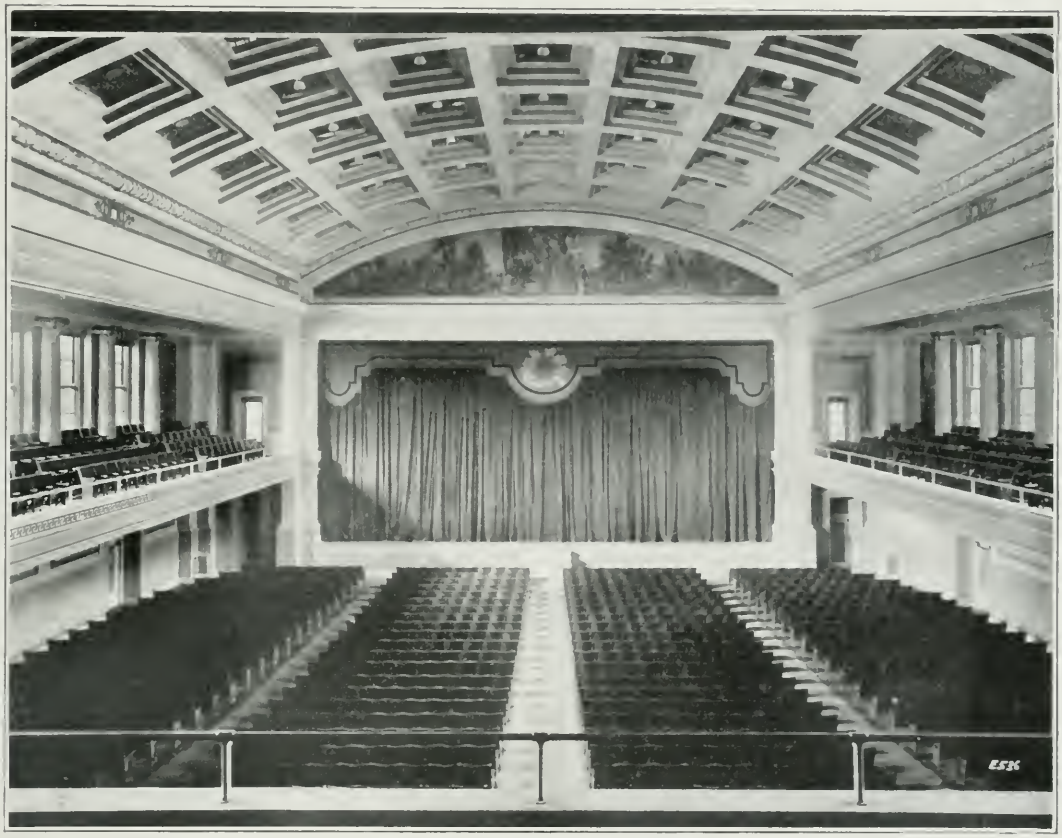
SECOND FLOOR PLAN.

MAIN BUILDING, CARTER H. HARRISON TECHNICAL HIGH SCHOOL, CHICAGO, ILL.

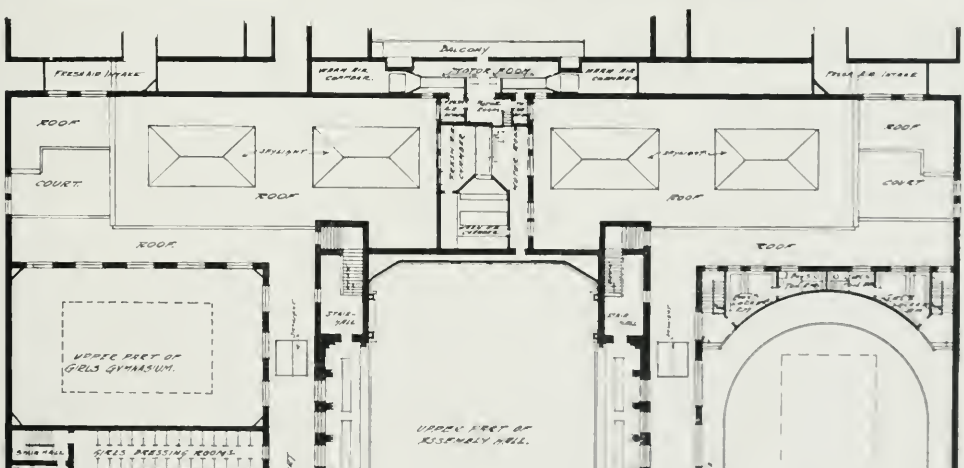


SECOND FLOOR PLAN.

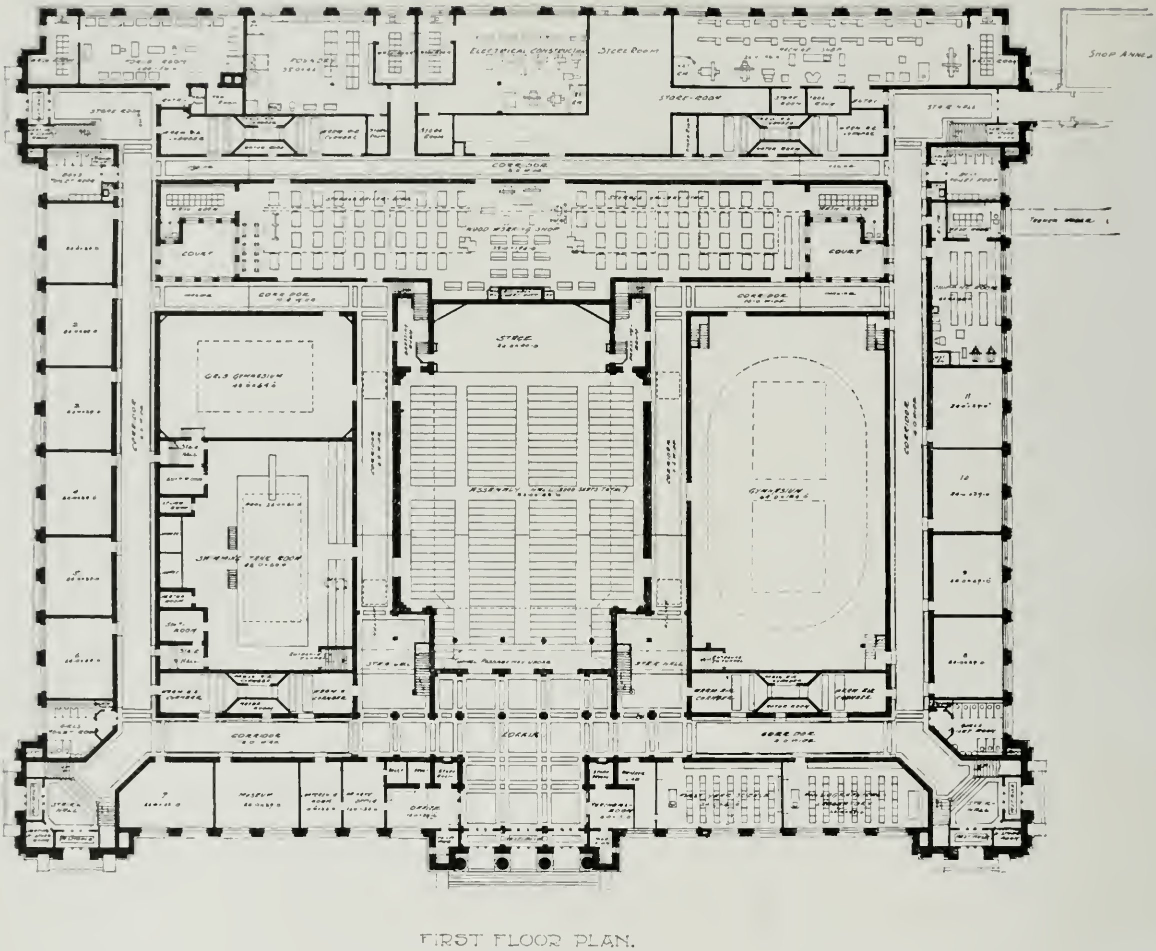
SHOP ANNEX, CARTER H. HARRISON TECHNICAL HIGH SCHOOL, CHICAGO, ILL.



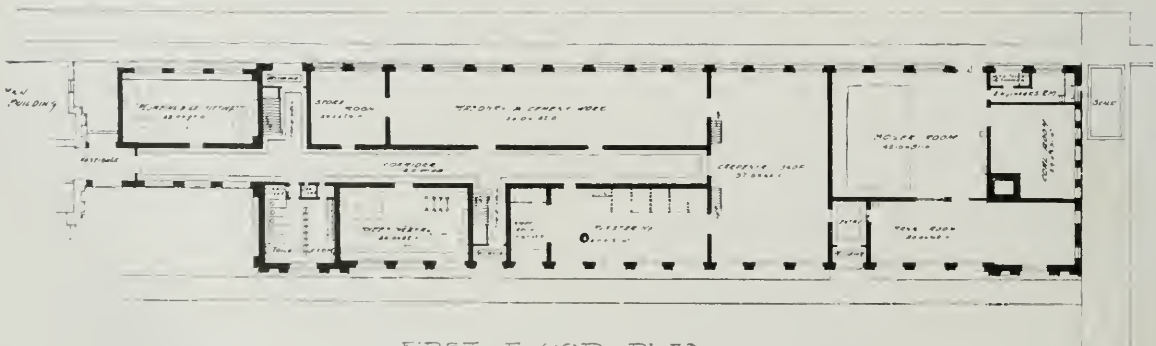
AUDITORIUM, CARTER H. HARRISON TECHNICAL HIGH SCHOOL, CHICAGO, ILL.



MEZZANINE FLOOR PLAN, CARTER H. HARRISON TECHNICAL HIGH SCHOOL, CHICAGO, ILL.



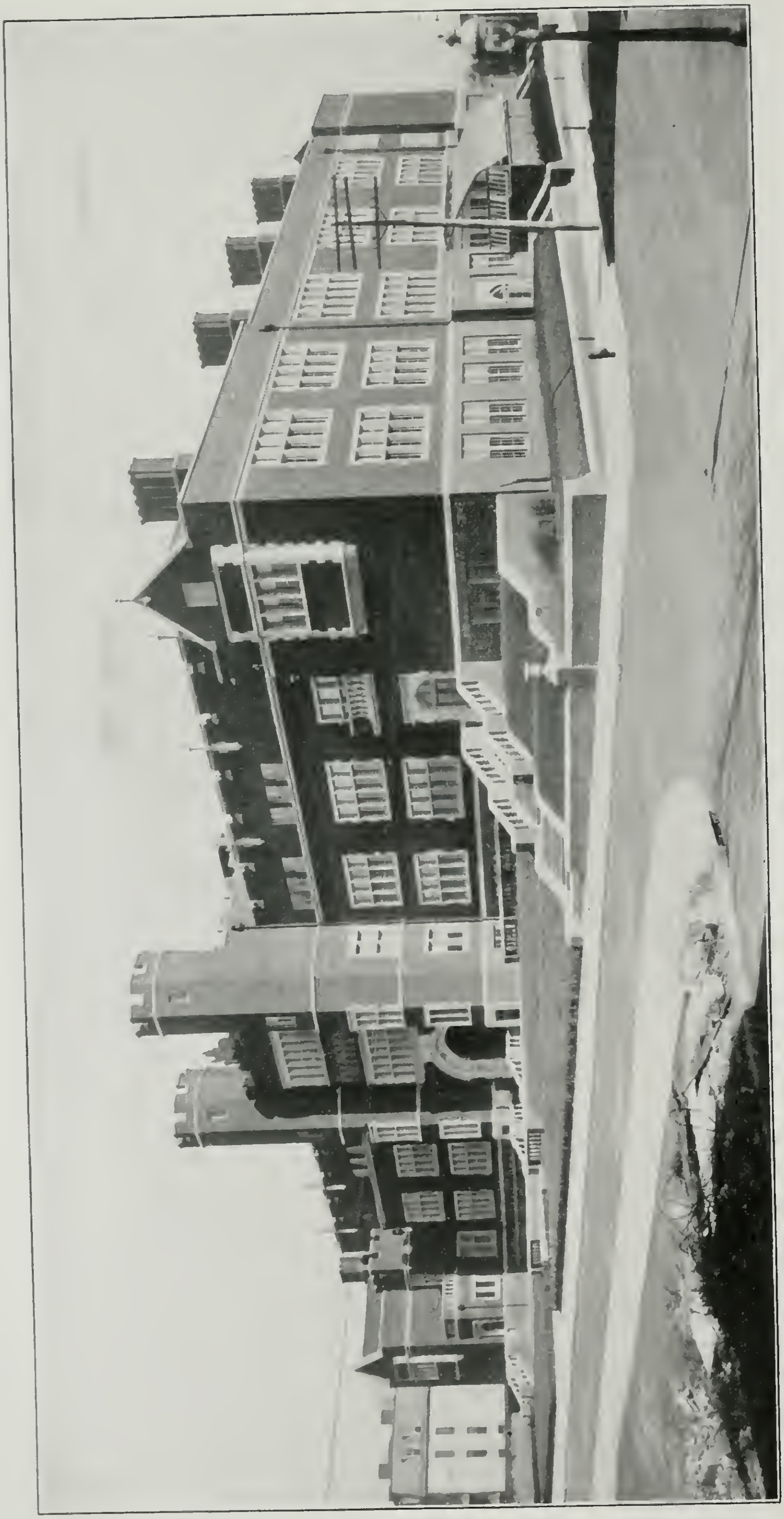
FIRST FLOOR PLAN, CARTER H. HARRISON TECHNICAL HIGH SCHOOL, CHICAGO, ILL.



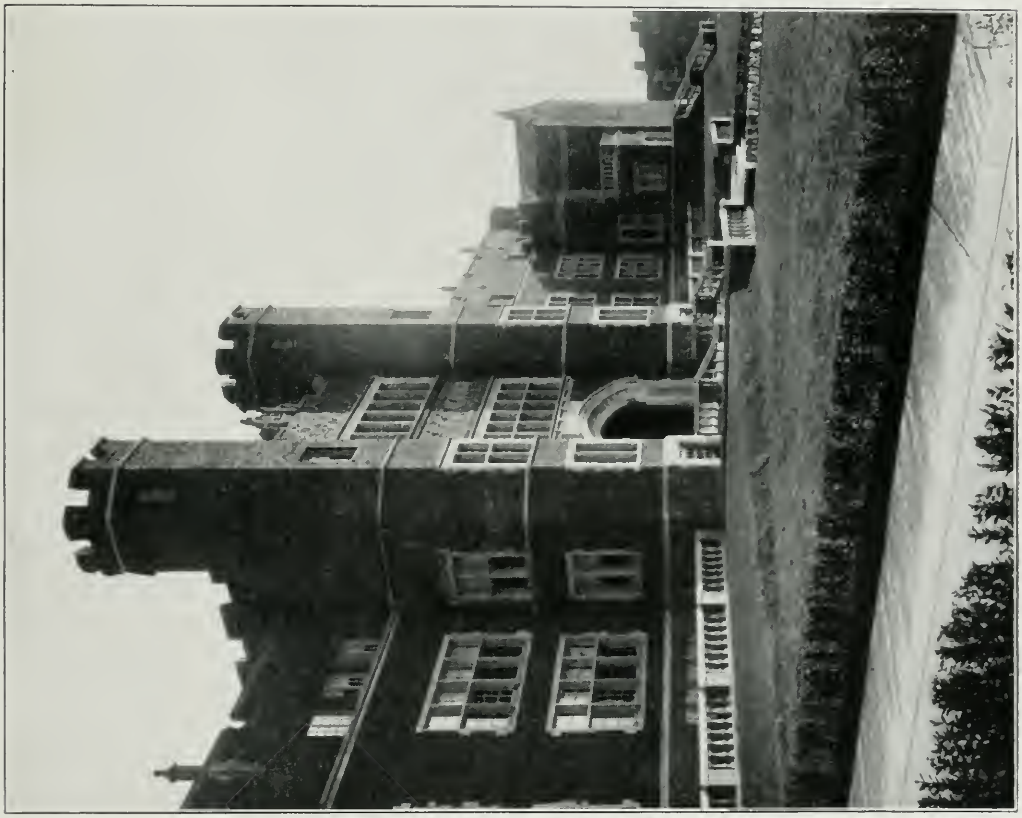
SHOP ANNEX, CARTER H. HARRISON TECHNICAL HIGH SCHOOL, CHICAGO, ILL.

AUDITORIUM, GROVER CLEVELAND HIGH SCHOOL, ST. LOUIS, MO.
William B. Ittner, Architect, St. Louis.

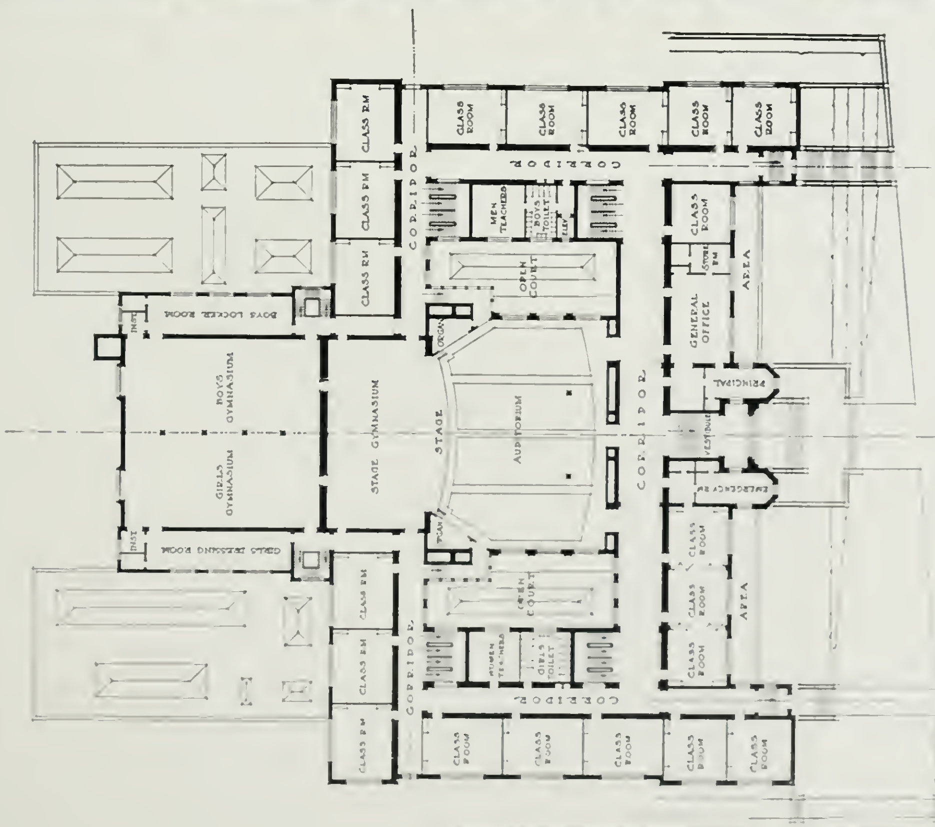
REAR VIEW, GROVER CLEVELAND HIGH SCHOOL, ST. LOUIS, MO.



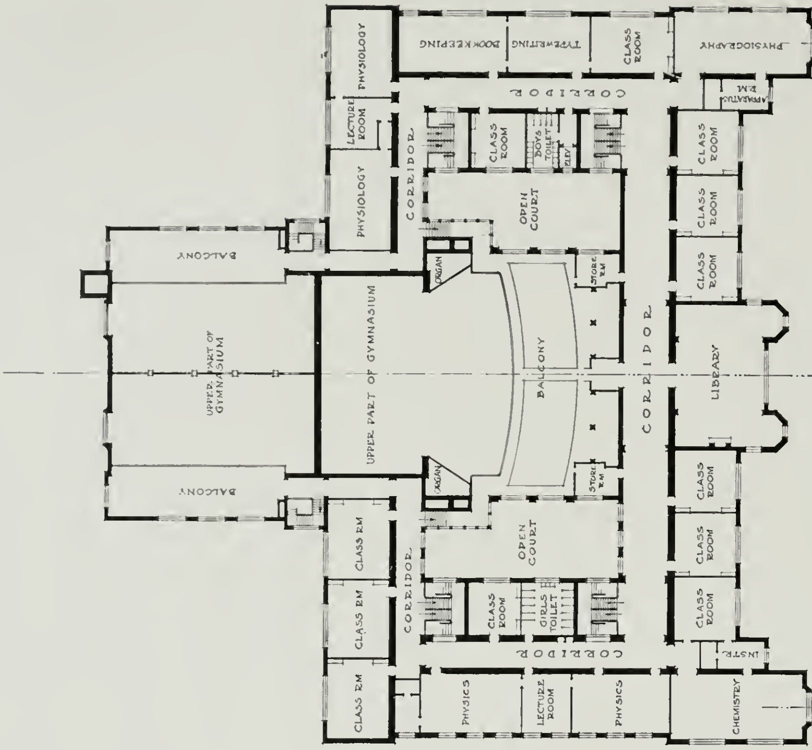
GROVER CLEVELAND HIGH SCHOOL, ST. LOUIS, MO.
William B. Ittner, Architect, St. Louis.



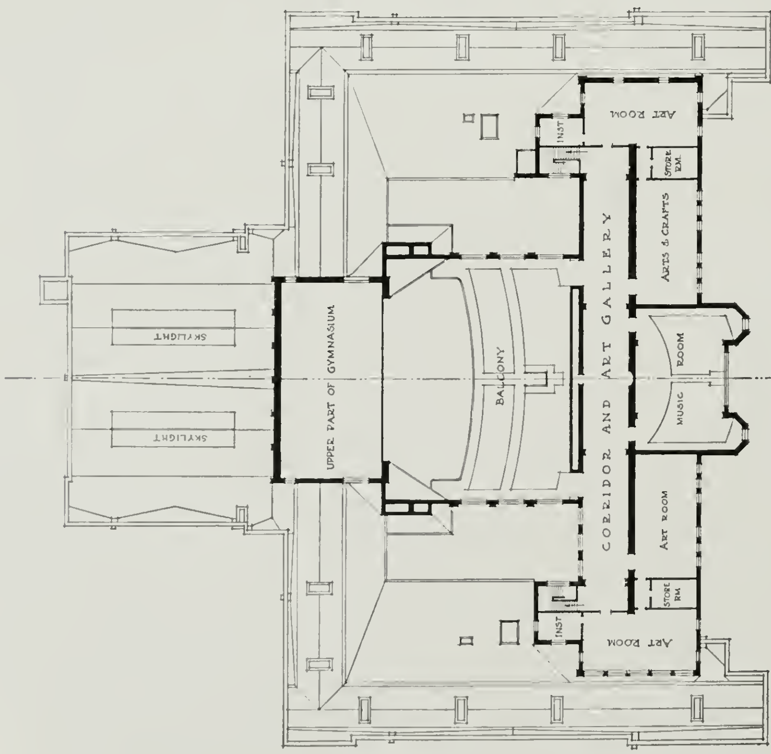
DETAIL OF THE WEST FRONT, GROVER CLEVELAND HIGH SCHOOL, ST. LOUIS, MO.



FIRST FLOOR PLAN
SCALE 1/32"=1'0"

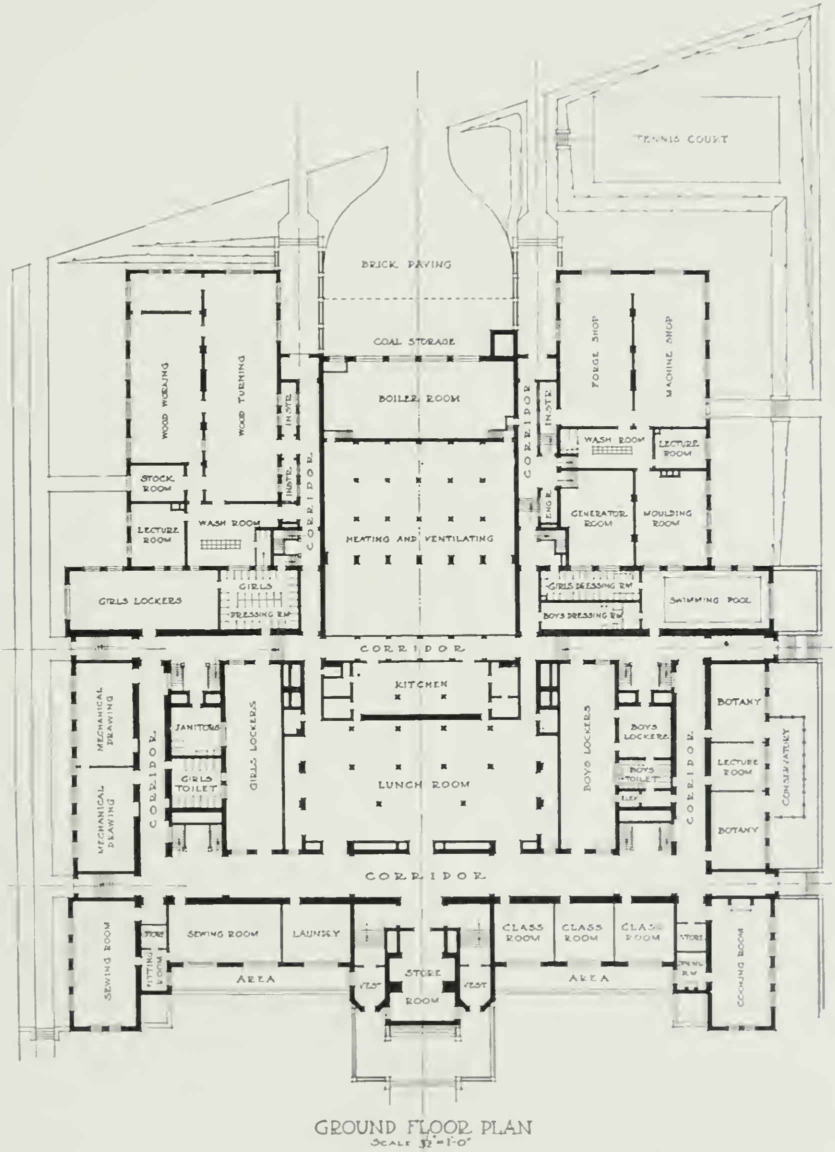


SECOND FLOOR PLAN
SCALE $\frac{1}{32}$" = 1'-0"



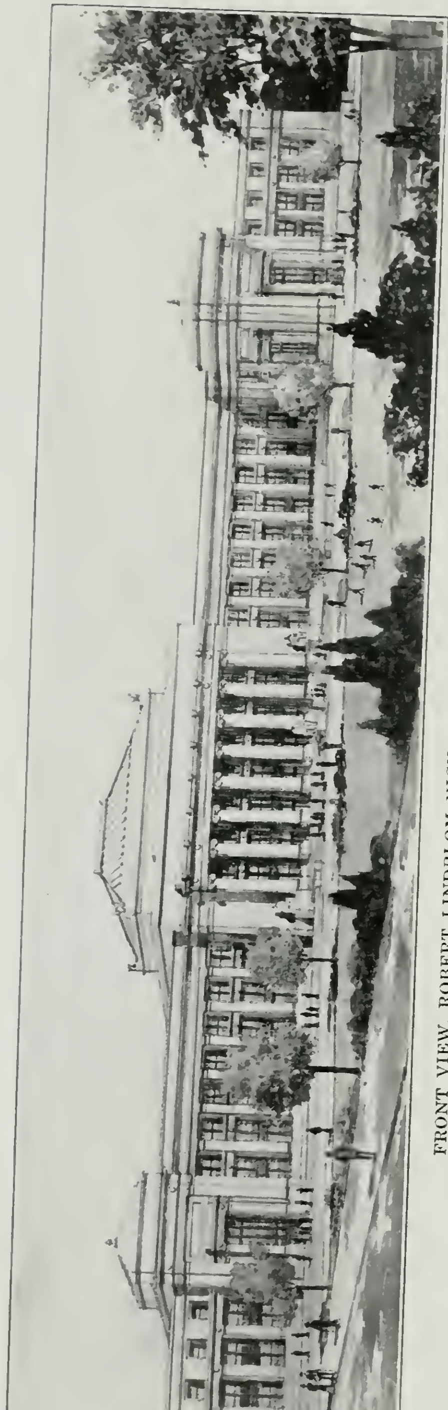
THIRD FLOOR PLAN
SCALE $\frac{1}{32}$" = 1'-0"

GROVER CLEVELAND HIGH SCHOOL, ST. LOUIS, MO.

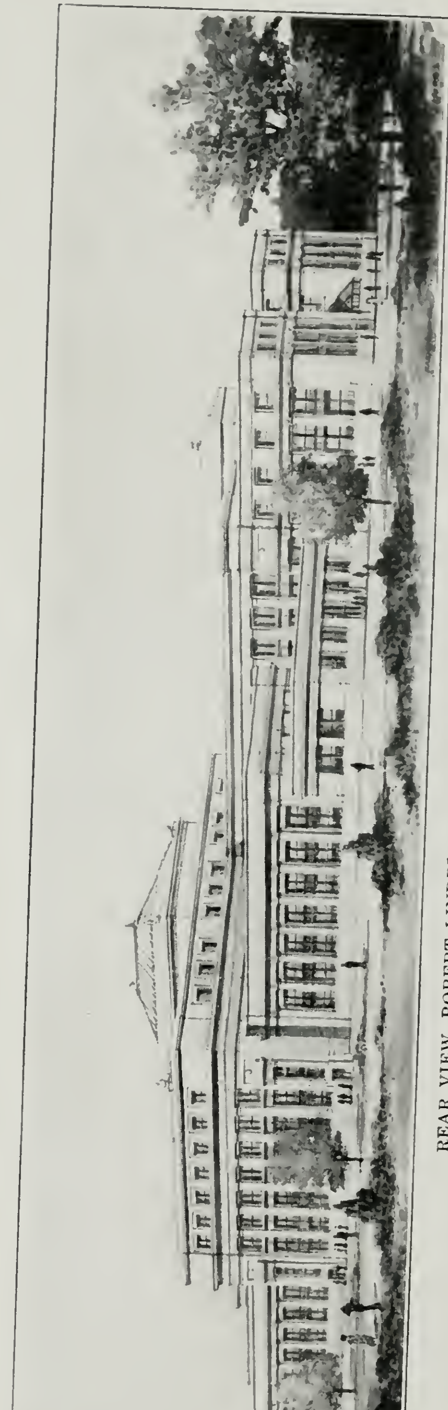


GROVER CLEVELAND HIGH SCHOOL, ST. LOUIS, MO.

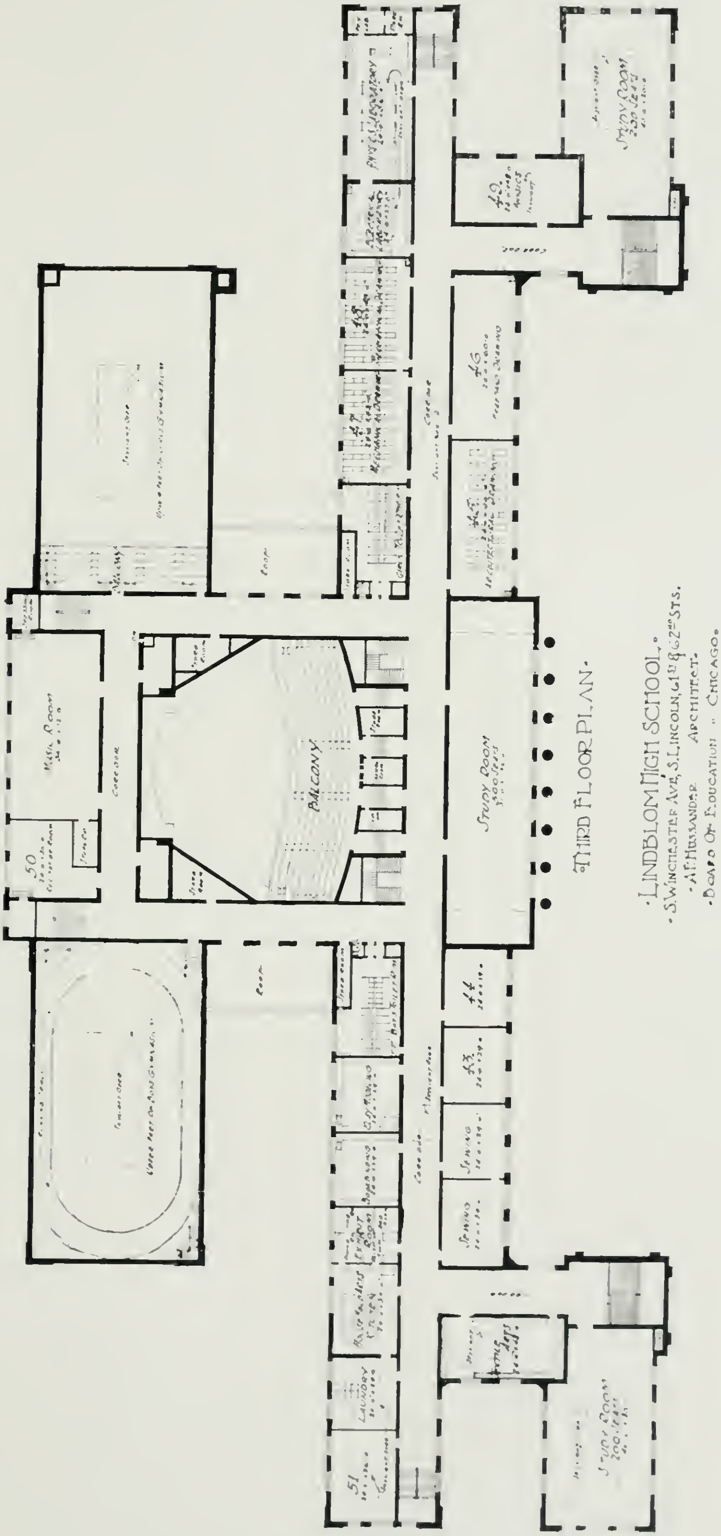
William B. Ittner, Architect, St. Louis.

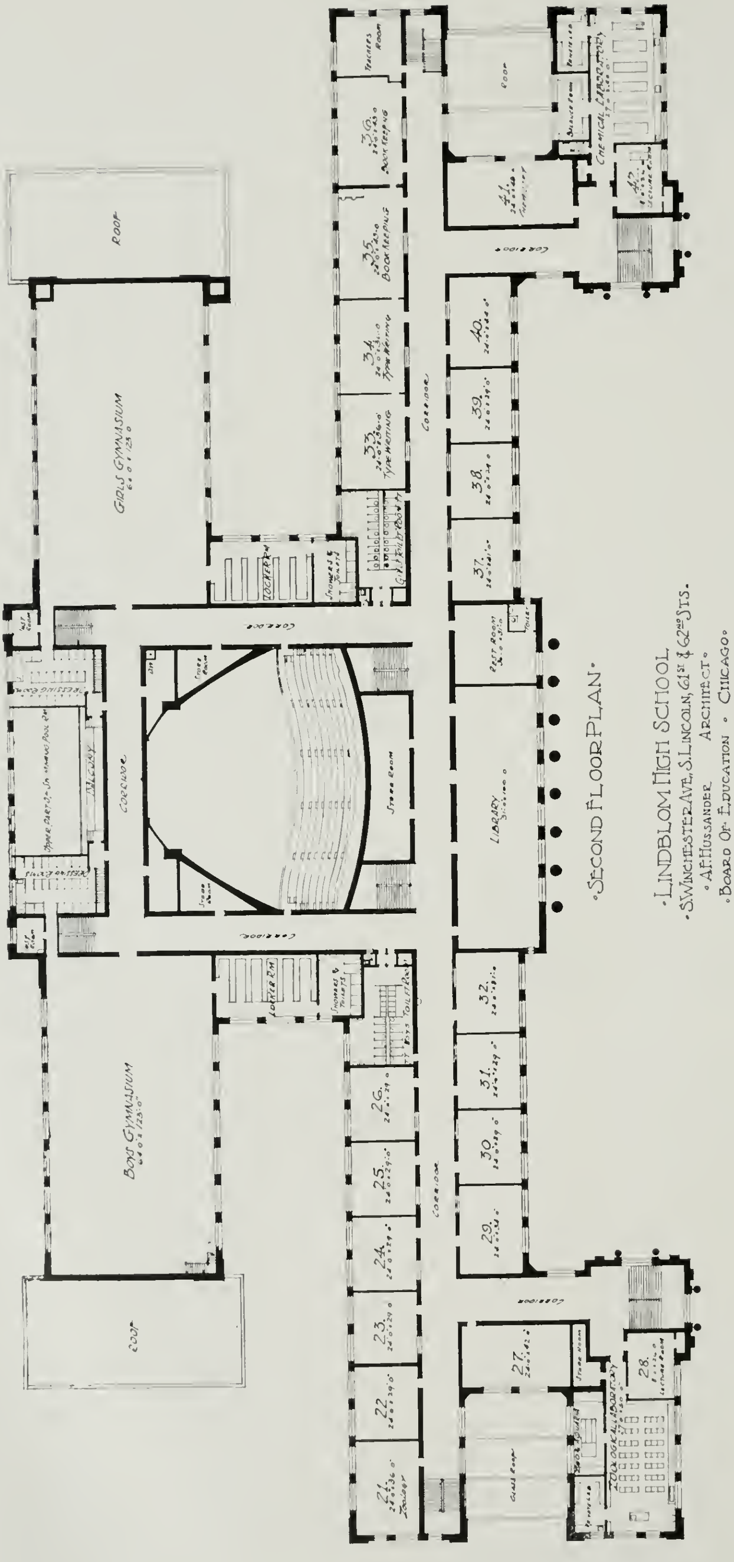


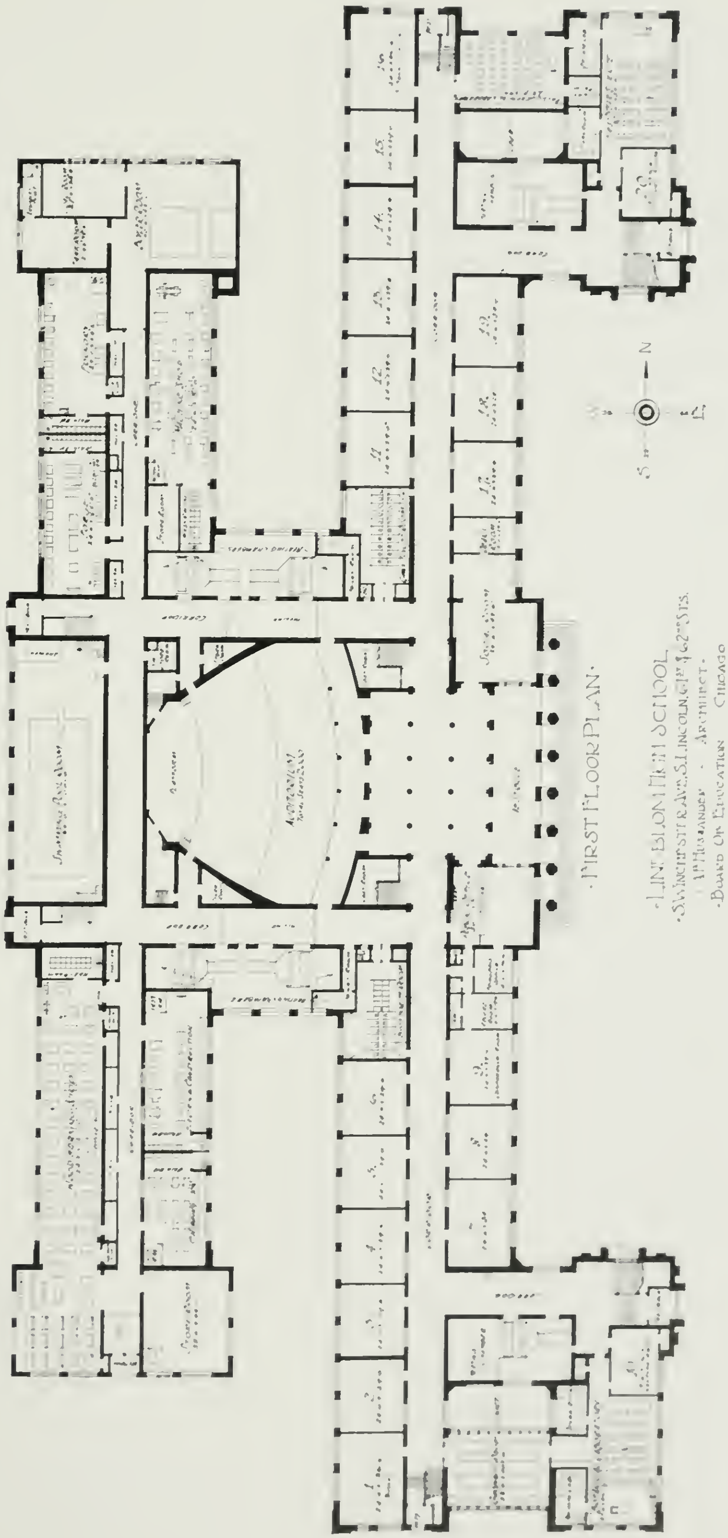
FRONT VIEW, ROBERT LINDBLOM HIGH SCHOOL, CHICAGO, ILL.
A. F. Hussander, Architect, Chicago, Ill.

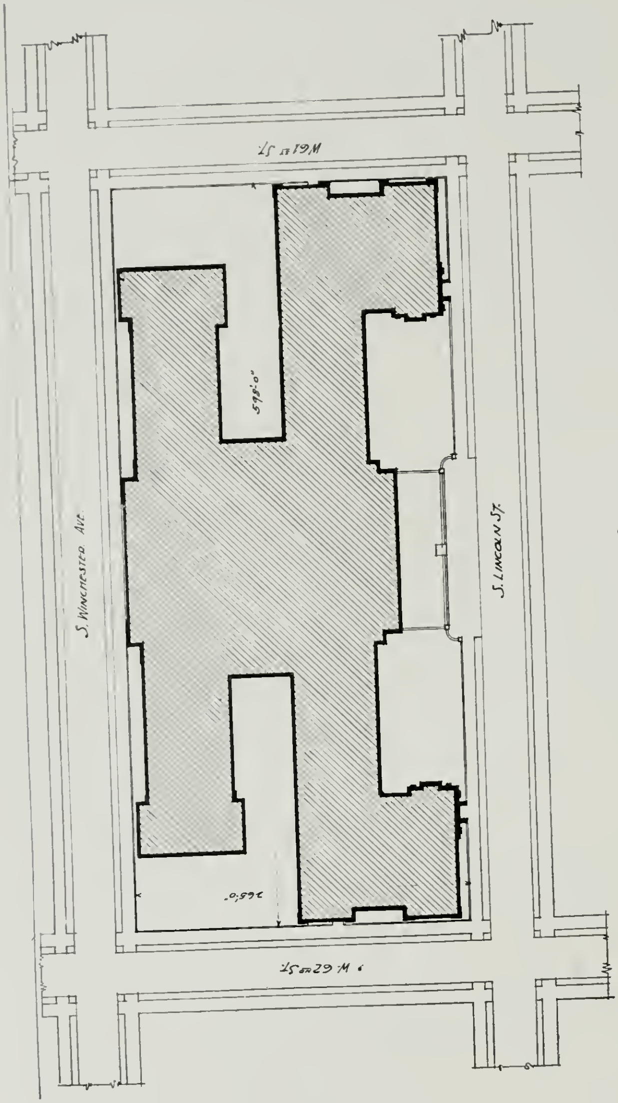


REAR VIEW, ROBERT LINDBLOM HIGH SCHOOL, CHICAGO, ILL.
A. F. Hussander, Architect, Chicago, Ill.


THIRD FLOOR PLAN
LINDBLOM HIGH SCHOOL
S. WINCHESTER AVE, S. LINCOLN, 61ST & 62ND STS.
A. F. HUSSANDER ARCHITECT
BOARD OF EDUCATION - CHICAGO

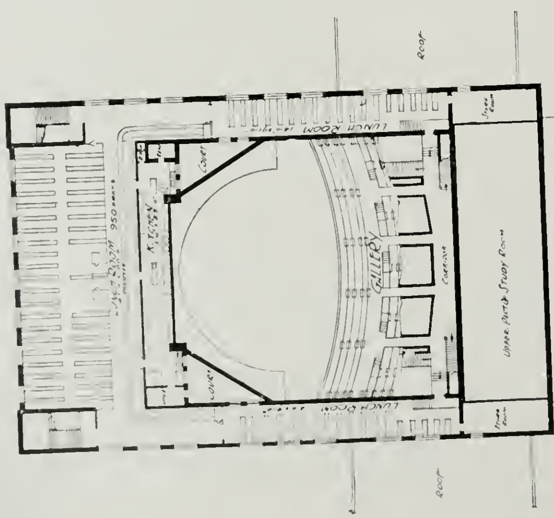

·Second Floor Plan·
·Lindblom High School
·S. Winchester Ave, S. Lincoln, 61st & 62nd Sts.
·A. F. Hussander Architect·
·Board of Education · Chicago·


· FIRST FLOOR PLAN ·
· LINDBLOM HIGH SCHOOL
· S. WINCHESTER AVE. S. LINCOLN & 62ND STS.
· A F HUSSANDER · ARCHITECT ·
· BOARD OF EDUCATION CHICAGO

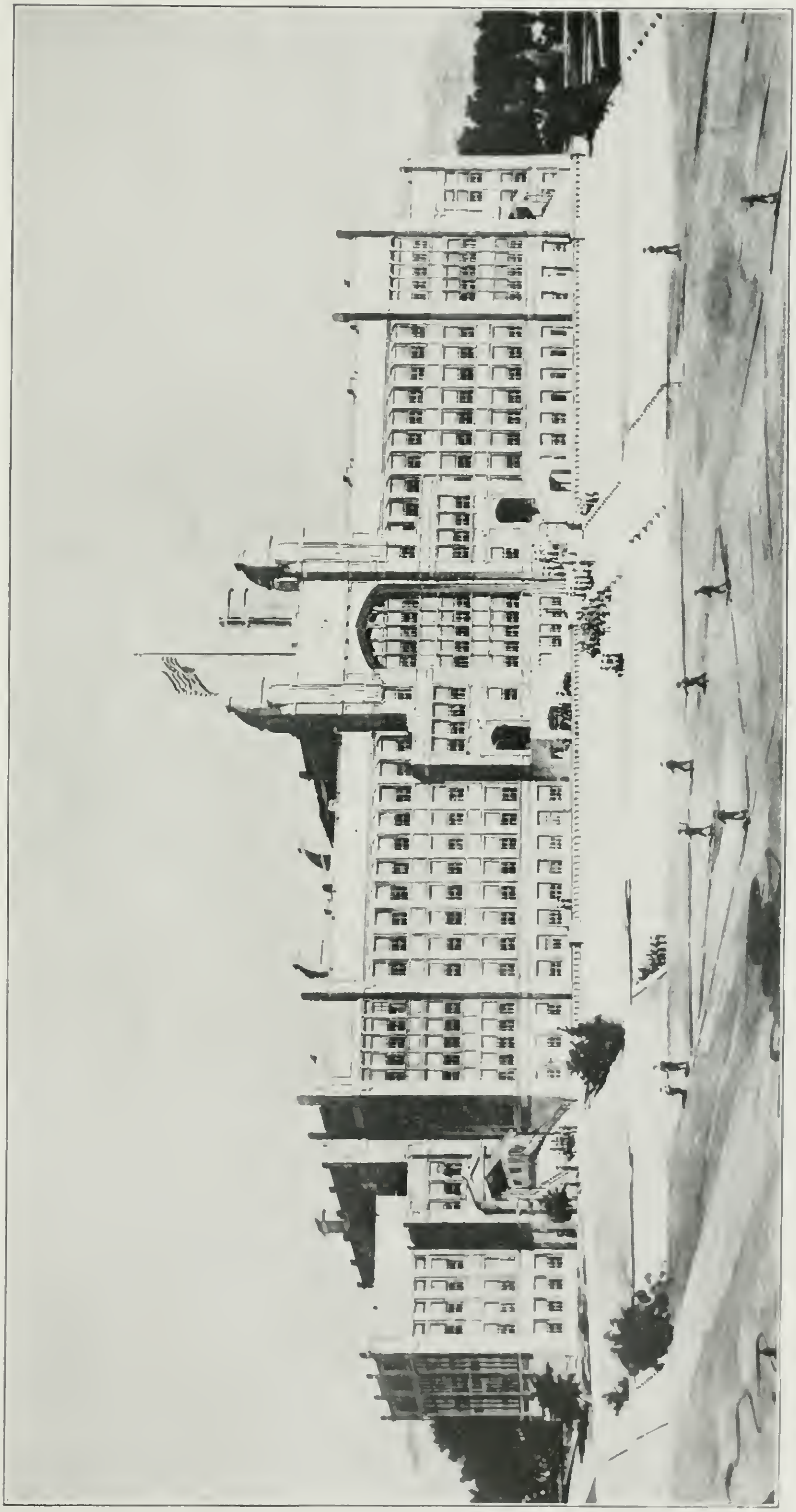


·PLAT PLAN·

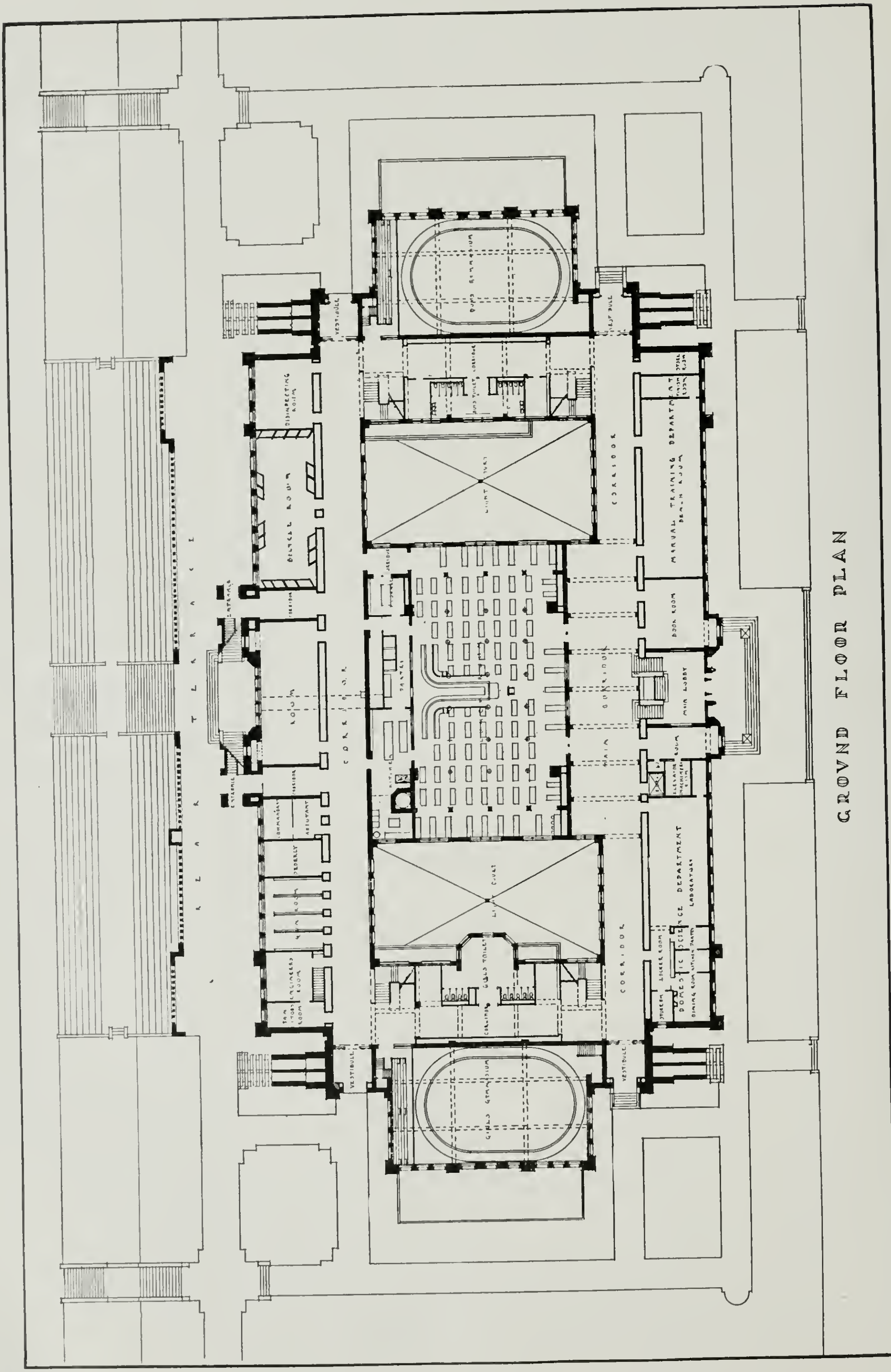
LINDBLOM HIGH SCHOOL, CHICAGO, ILL.



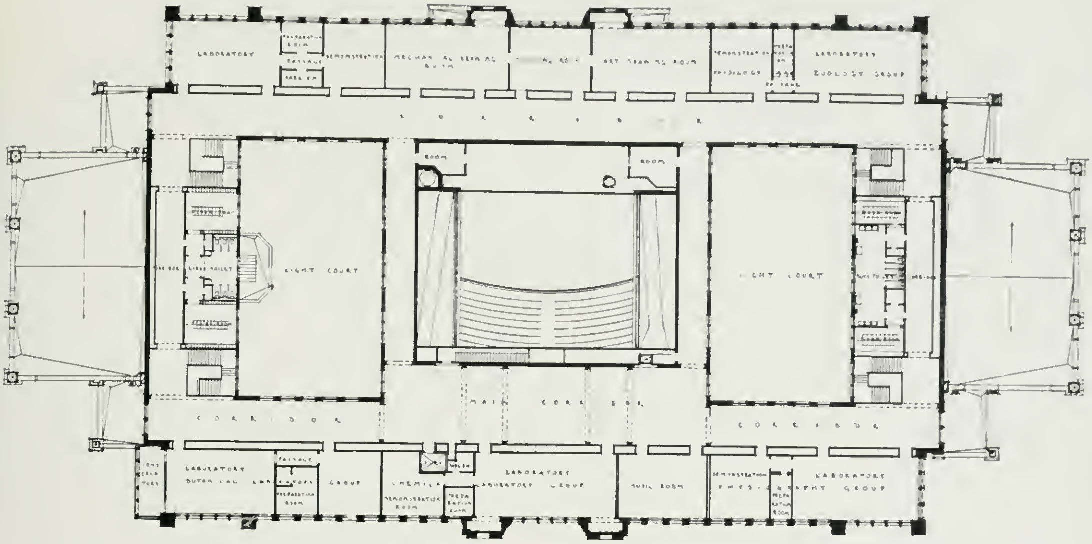
·LUNCH ROOM FLOOR PLAN·



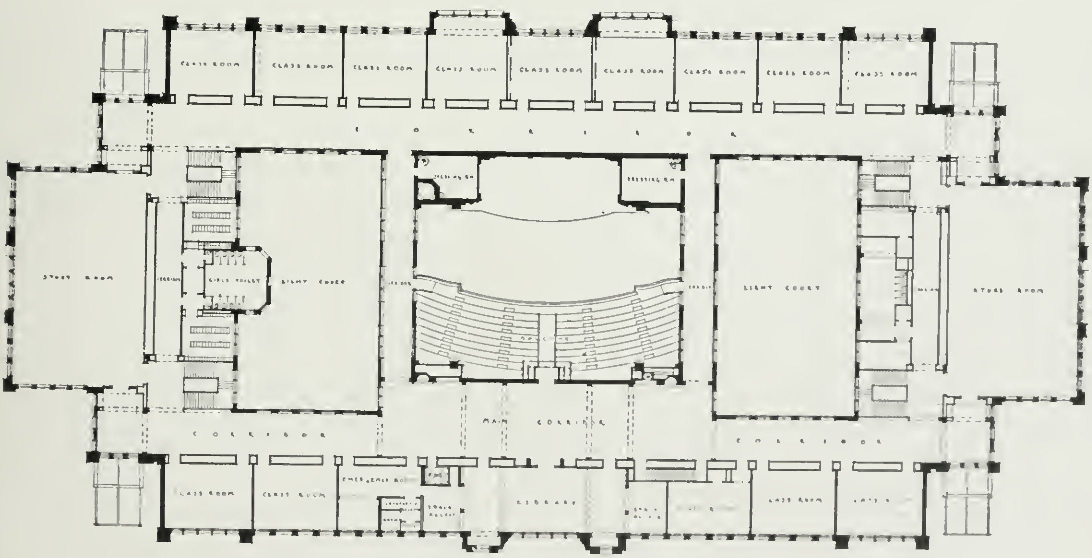
SALT LAKE HIGH SCHOOL, SALT LAKE CITY, UTAH.
Eldredge & Chesebro, Architects, Salt Lake City.



GROUND FLOOR AND PLAT PLAN, SALT LAKE HIGH SCHOOL, SALT LAKE CITY, UTAH.

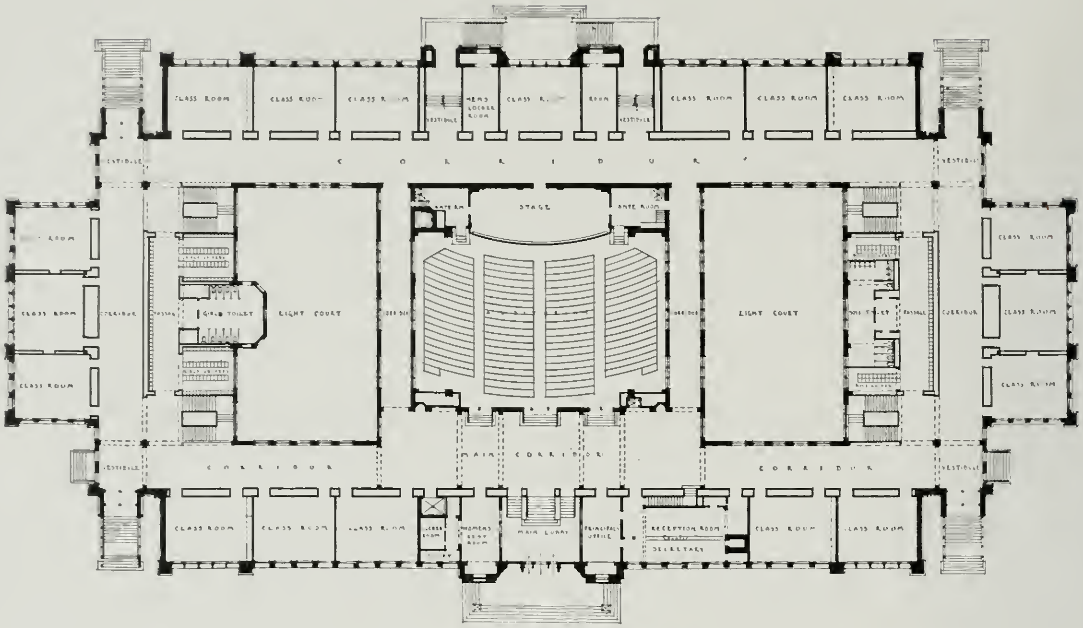


THIRD FLOOR PLAN



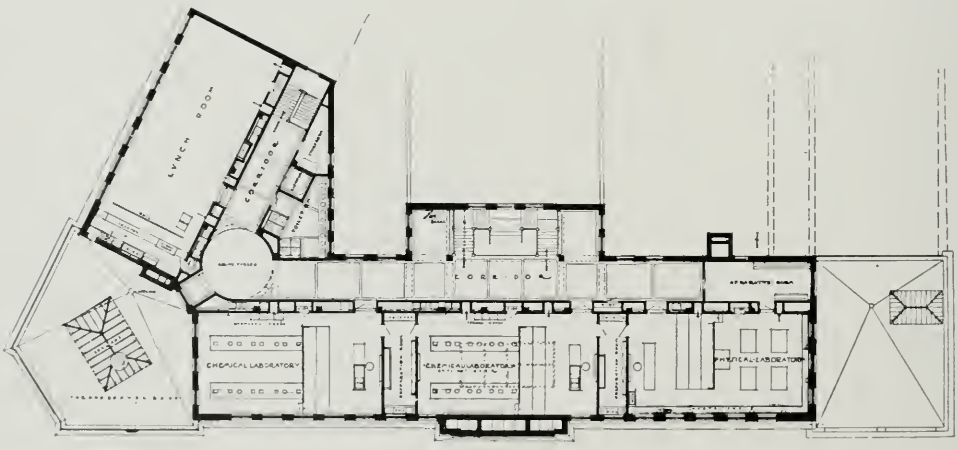
SECOND FLOOR PLAN

SALT LAKE HIGH SCHOOL, SALT LAKE CITY, UTAH.



FIRST FLOOR PLAN

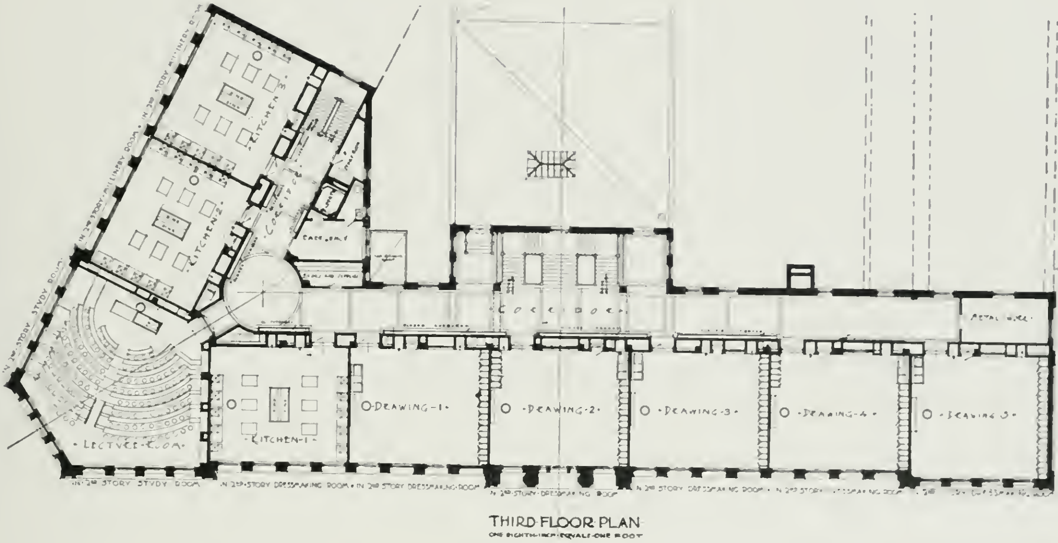
SALT LAKE HIGH SCHOOL, SALT LAKE CITY, UTAH.

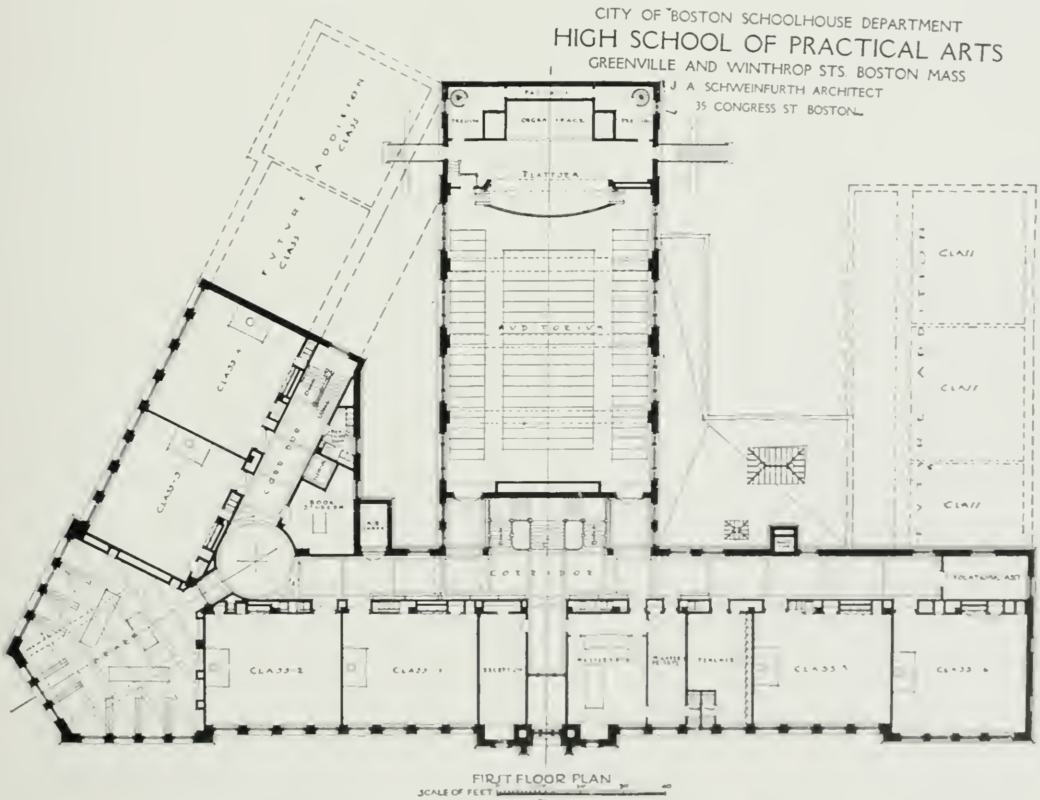


FOVRTH FLOOR-PLAN

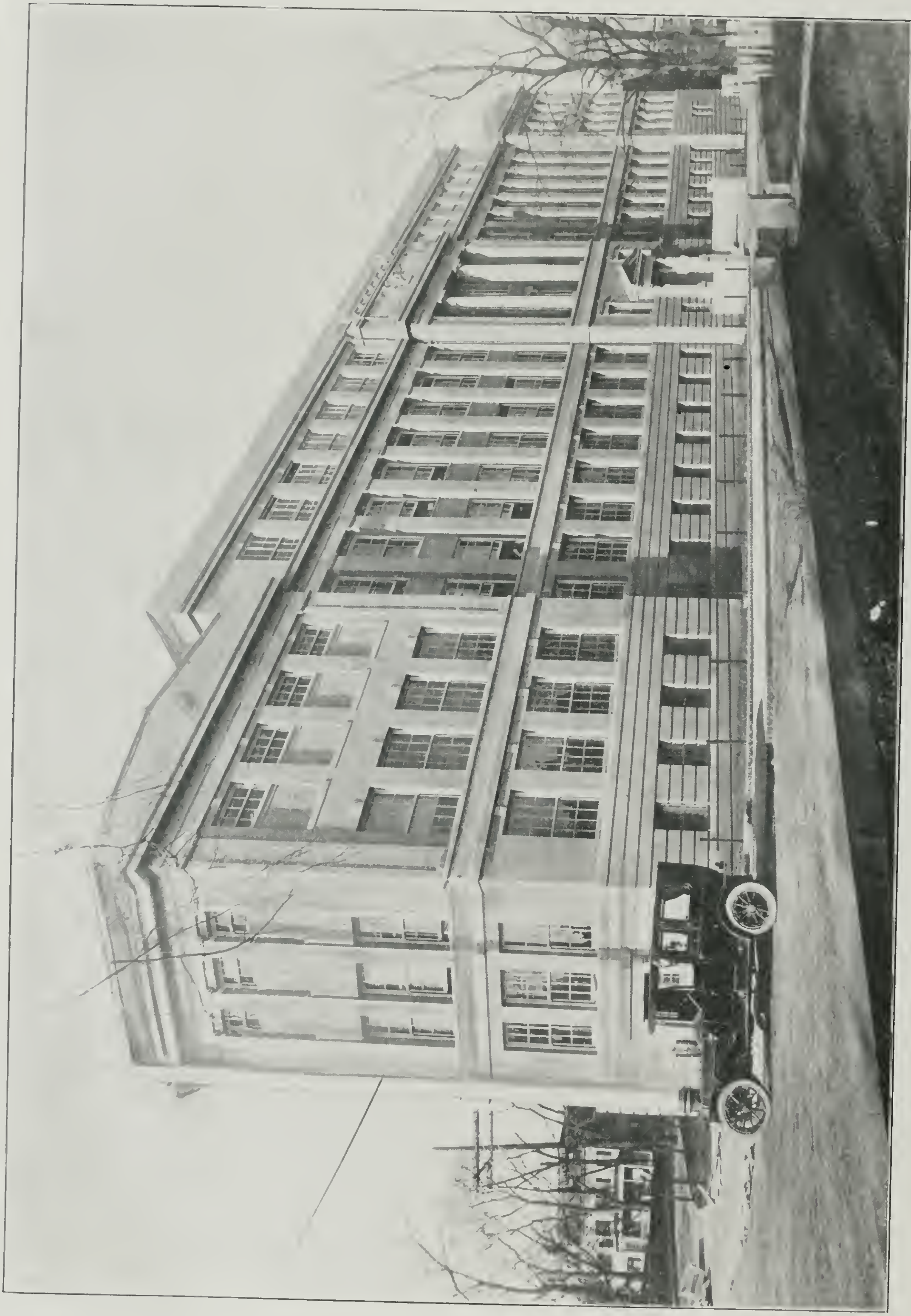
GIRLS' HIGH SCHOOL OF PRACTICAL ARTS, BOSTON, MASS.

J. A. Schweinfurth, Architect, Boston.



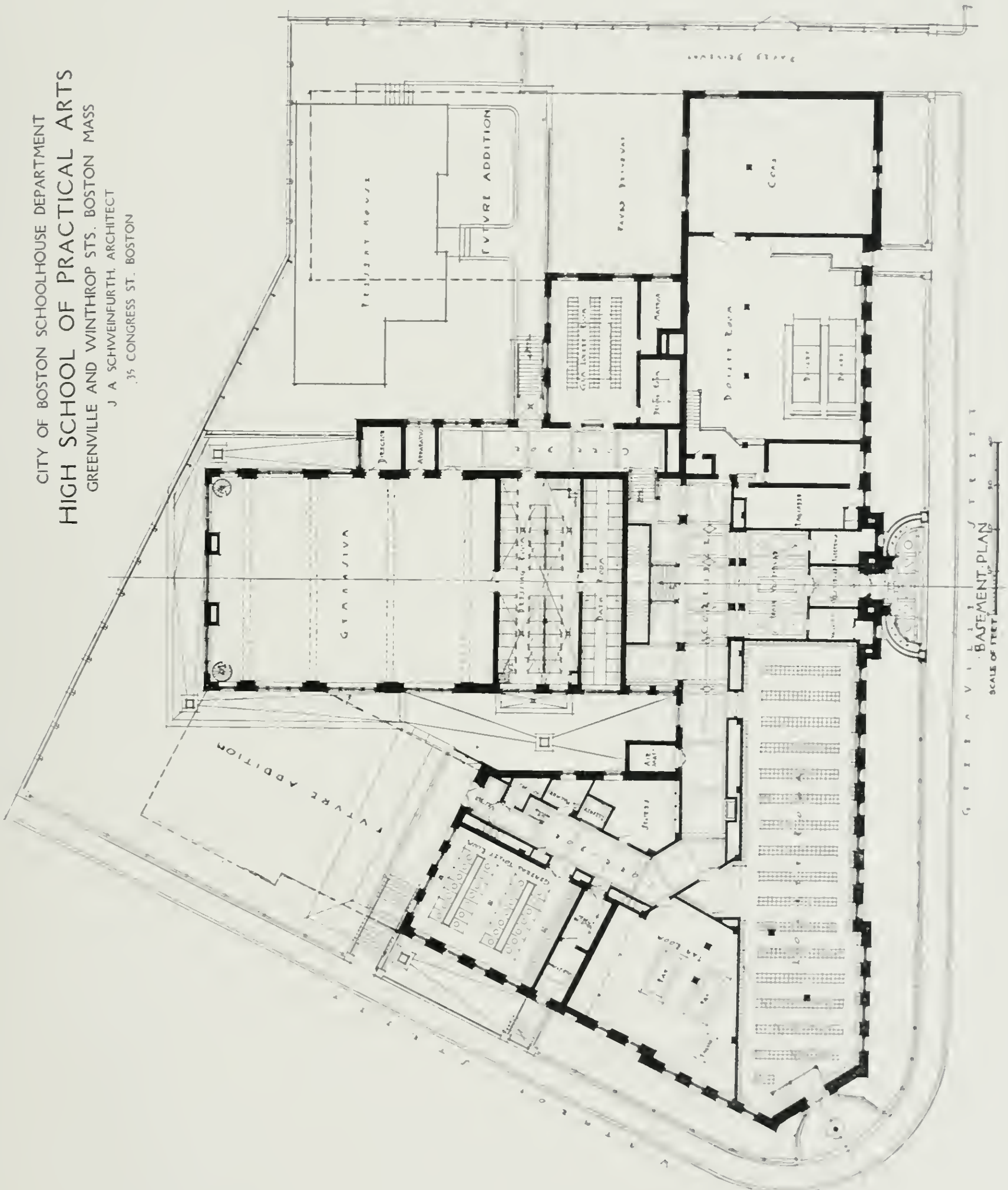


GIRLS' HIGH SCHOOL OF PRACTICAL ARTS, BOSTON, MASS.

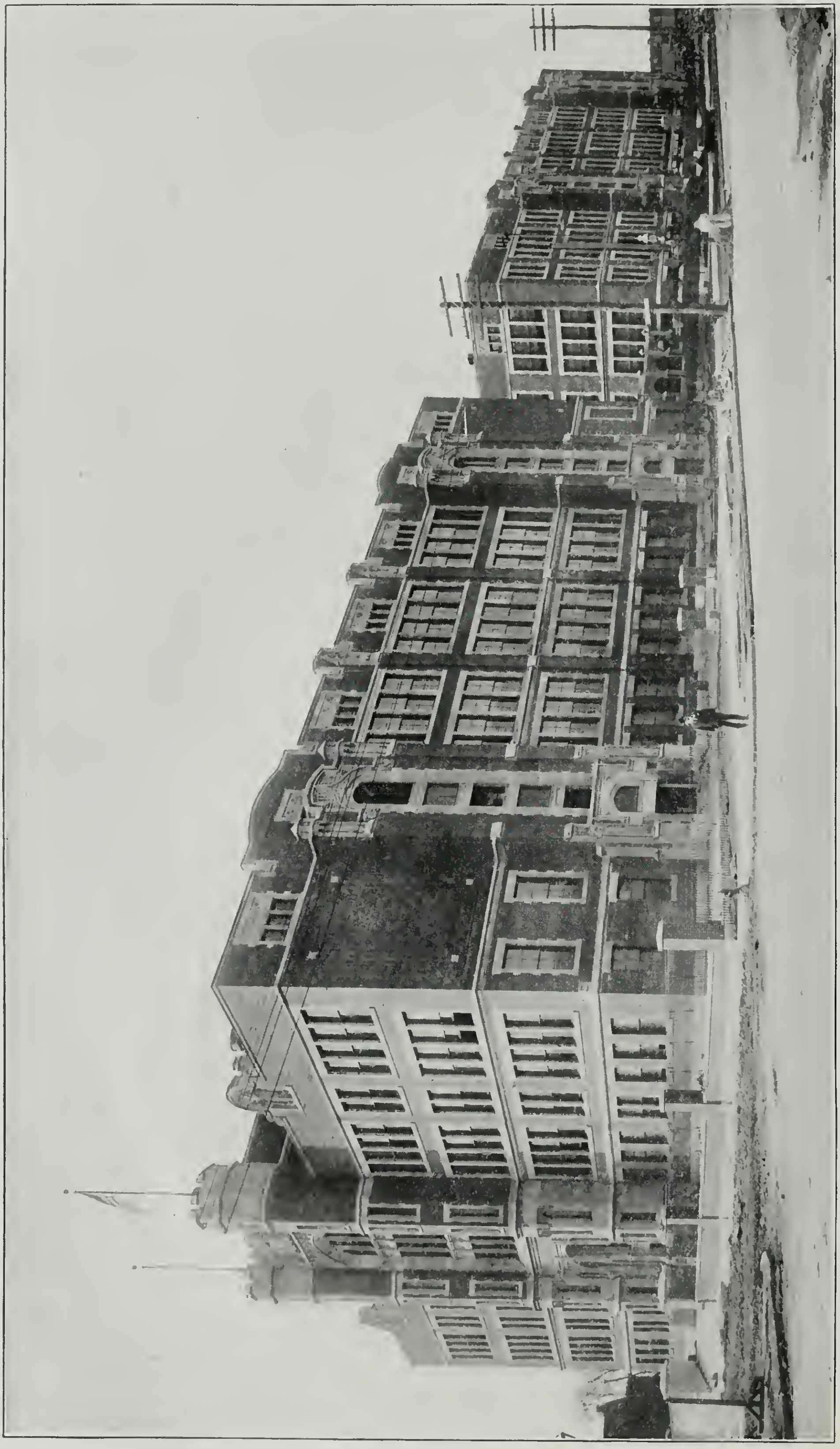


GIRLS' HIGH SCHOOL OF PRACTICAL ARTS, BOSTON, MASS.

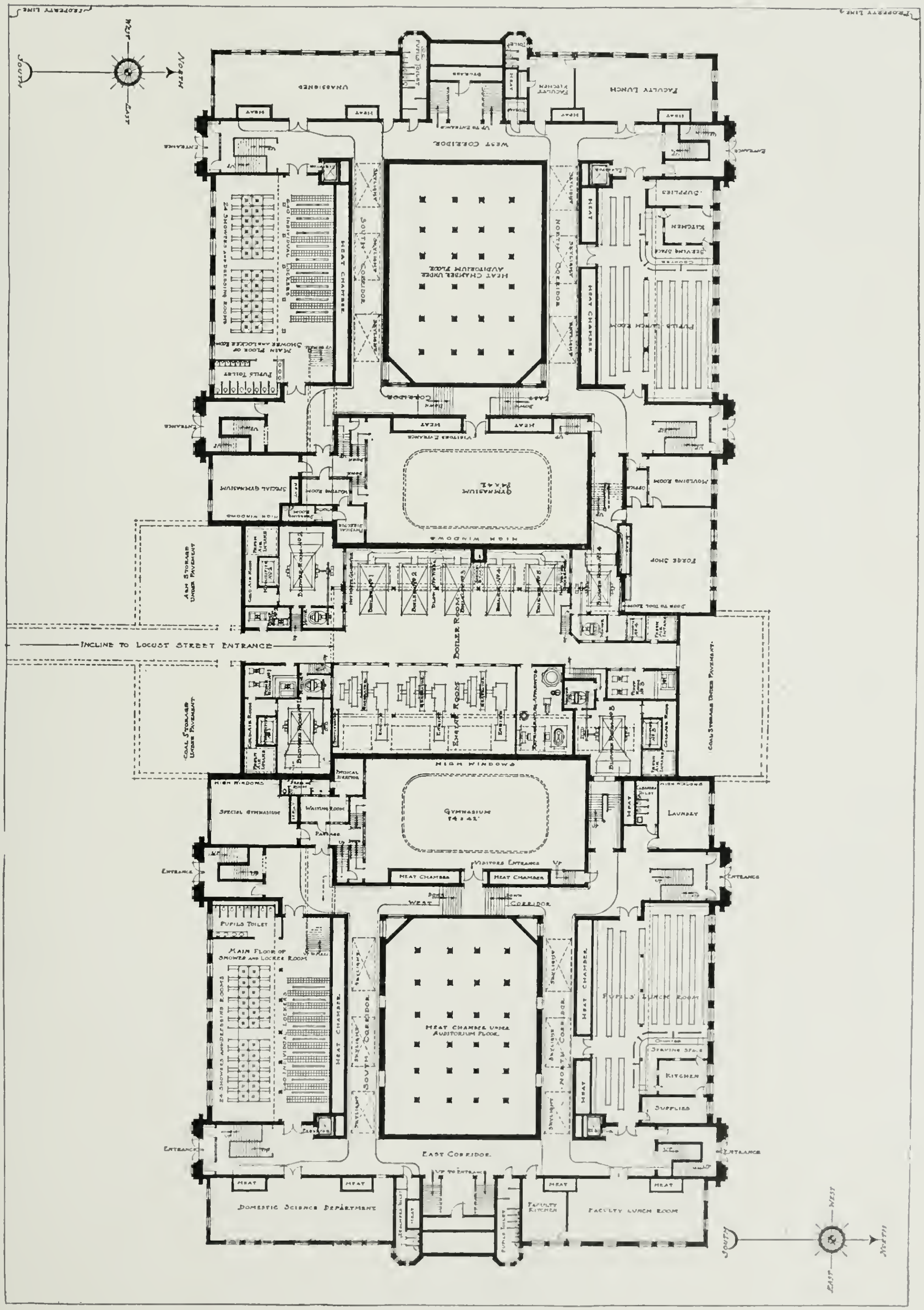
J. A. Schweinfurth, Architect, Boston.



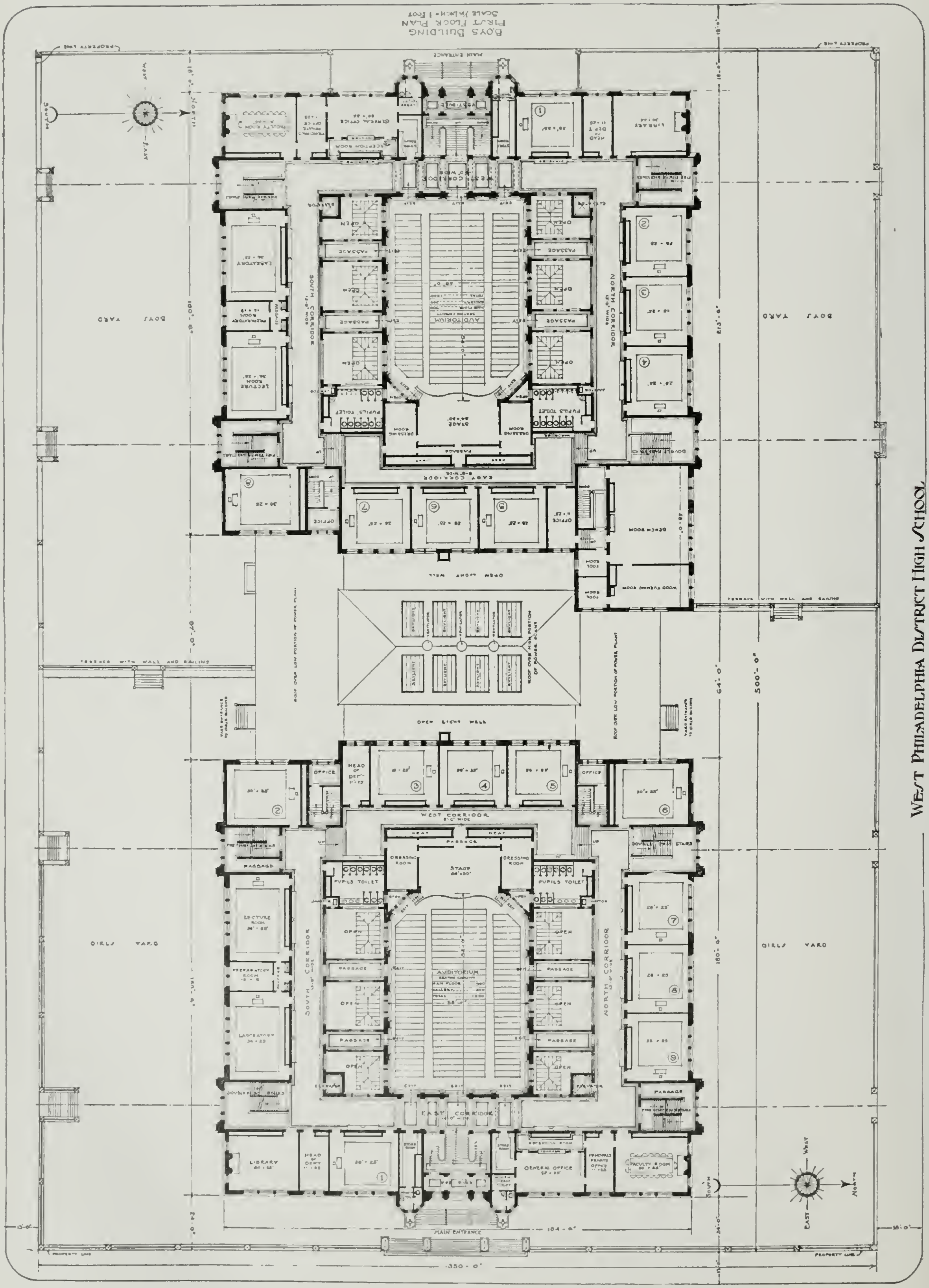
GIRLS' HIGH SCHOOL OF PRACTICAL ARTS, BOSTON, MASS.



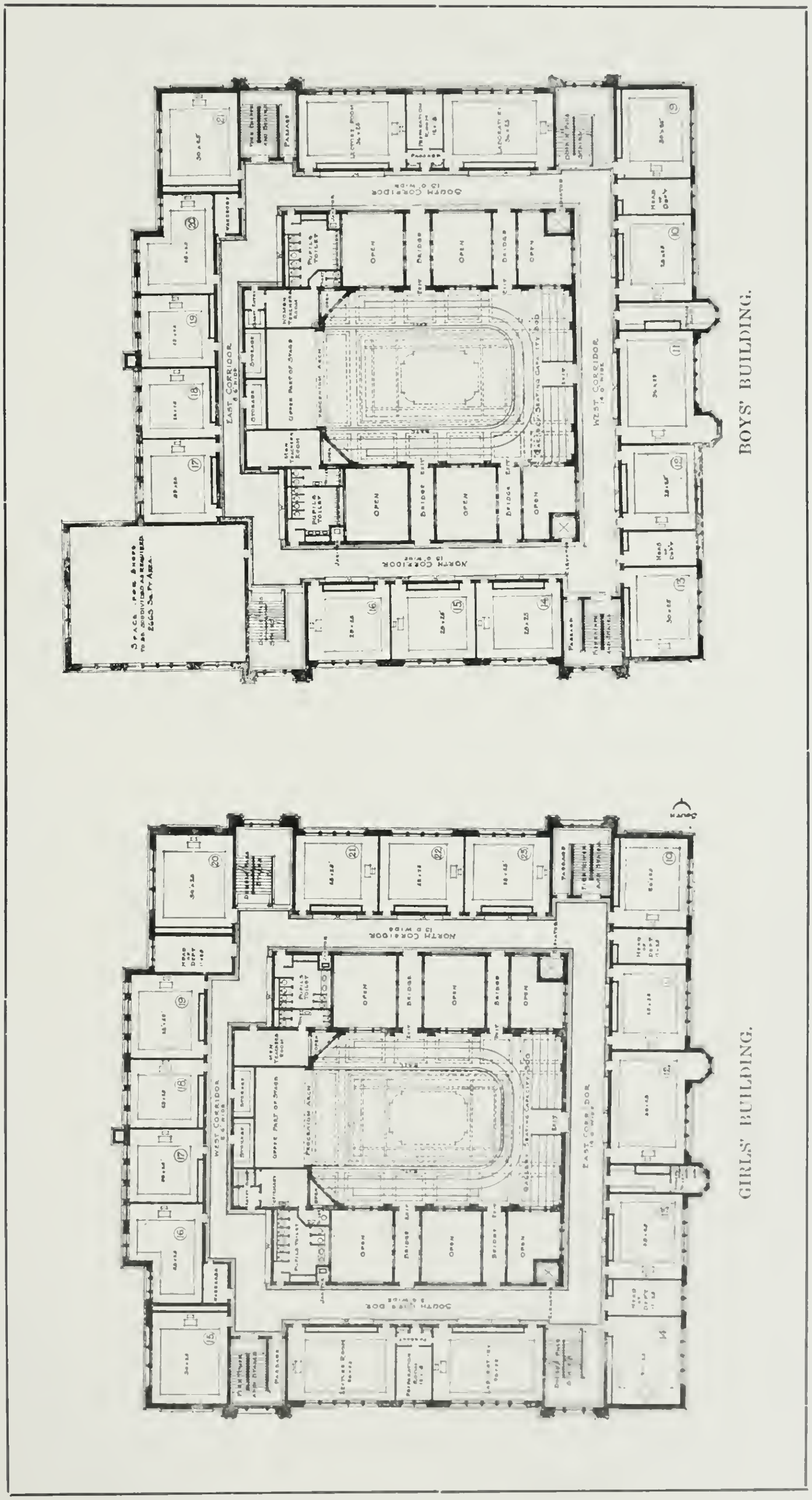
WEST PHILADELPHIA DISTRICT HIGH SCHOOL, PHILADELPHIA, PA.
J. Horace Cook, Architect; H. Courcy Richards, Designer, Philadelphia.



BASEMENT PLAN, WEST PHILADELPHIA DISTRICT HIGH SCHOOL, PHILADELPHIA, PA.



FIRST FLOOR PLAN, WEST PHILADELPHIA HIGH SCHOOL, PHILADELPHIA, PA.



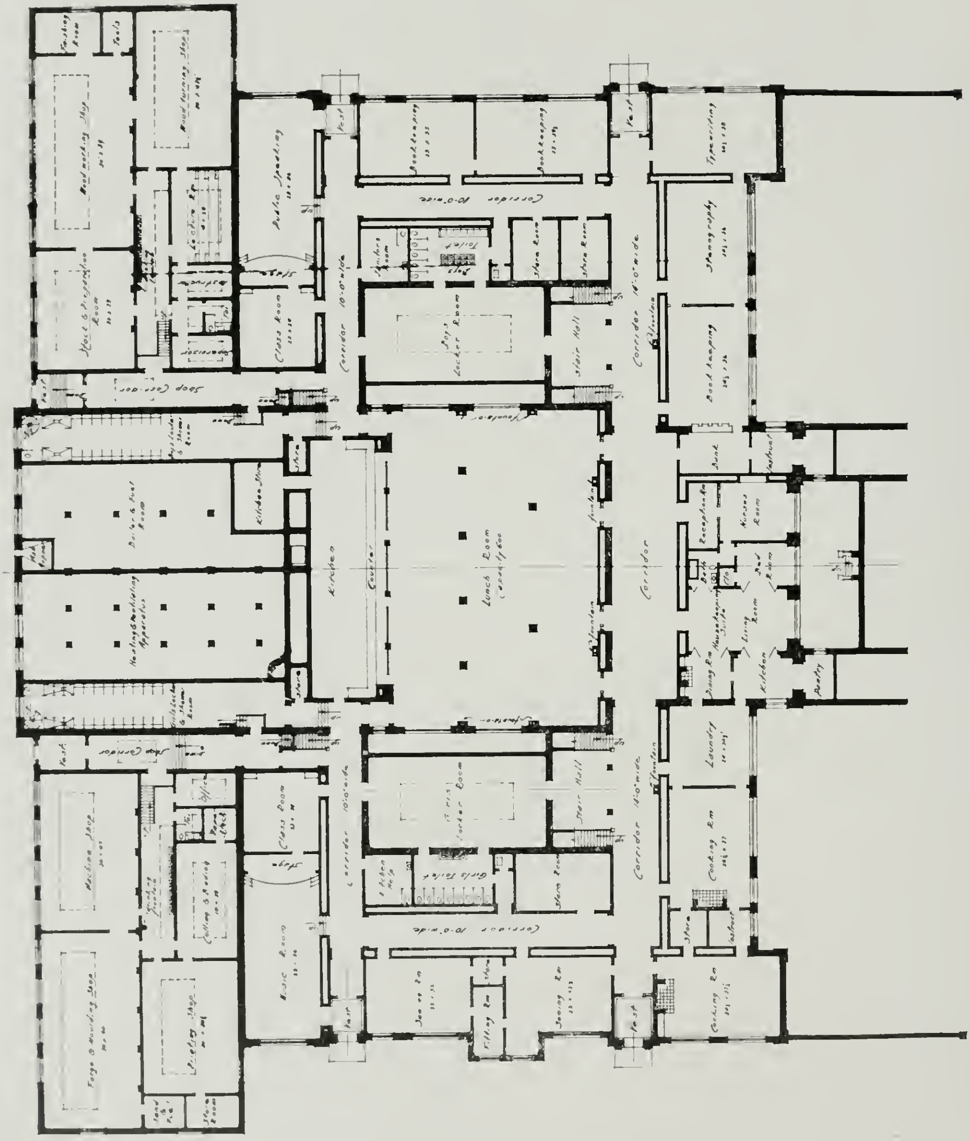
SECOND FLOOR PLAN, WEST PHILADELPHIA DISTRICT HIGH SCHOOL, PHILADELPHIA, PA.

BOYS' BUILDING.

GIRLS' BUILDING.

WEST PHILADELPHIA DISTRICT HIGH SCHOOL, PHILADELPHIA, PA.
J. Horace Cook, Architect; H. Courcy Richards, Designer, Philadelphia.

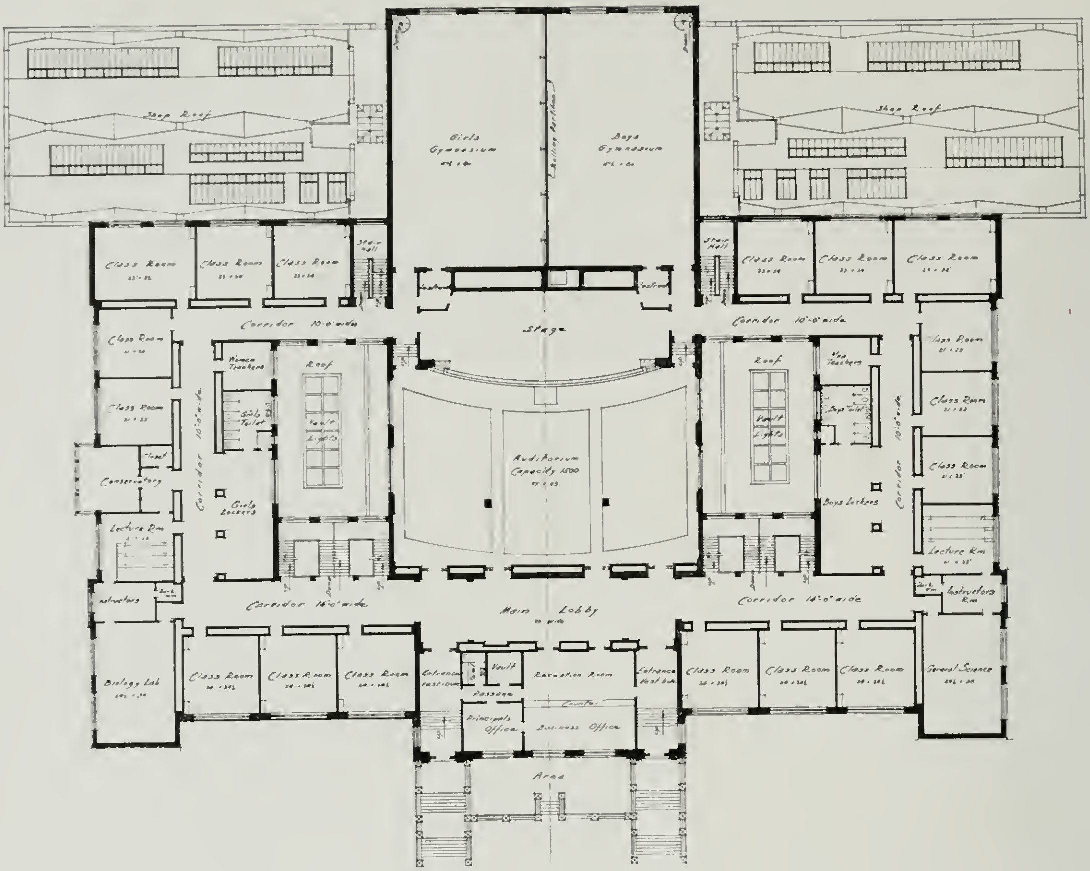
HIGH SCHOOL, SPRINGFIELD, ILL.
William B. Ittner, Architect, St. Louis, Mo.



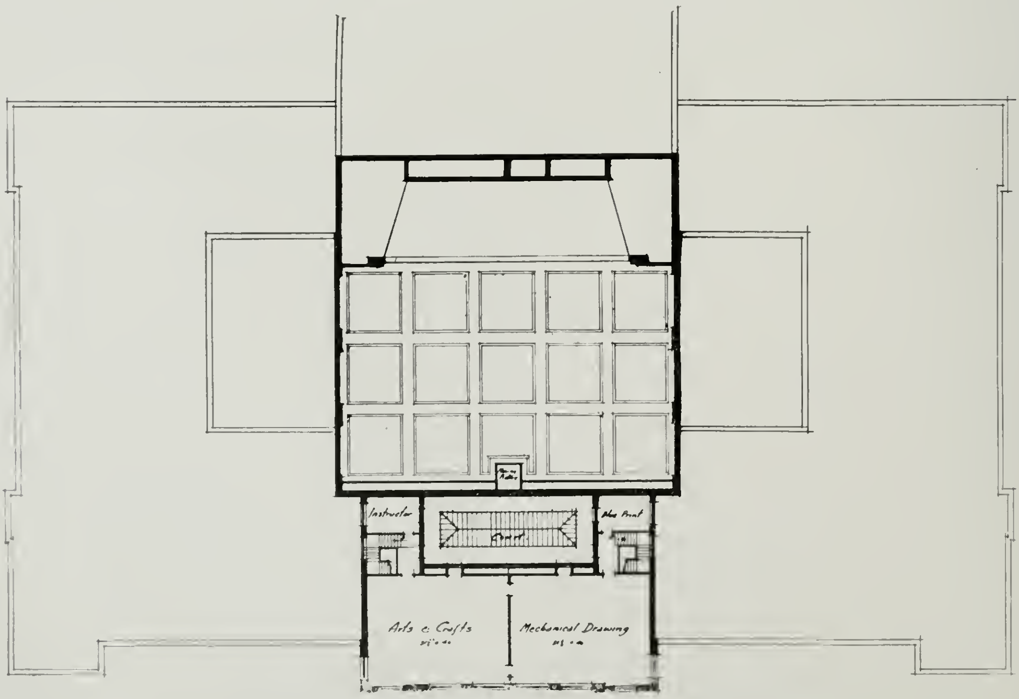
GROUND FLOOR PLAN, HIGH SCHOOL, SPRINGFIELD, ILL.

William B. Ittner, Architect, St. Louis, Mo.

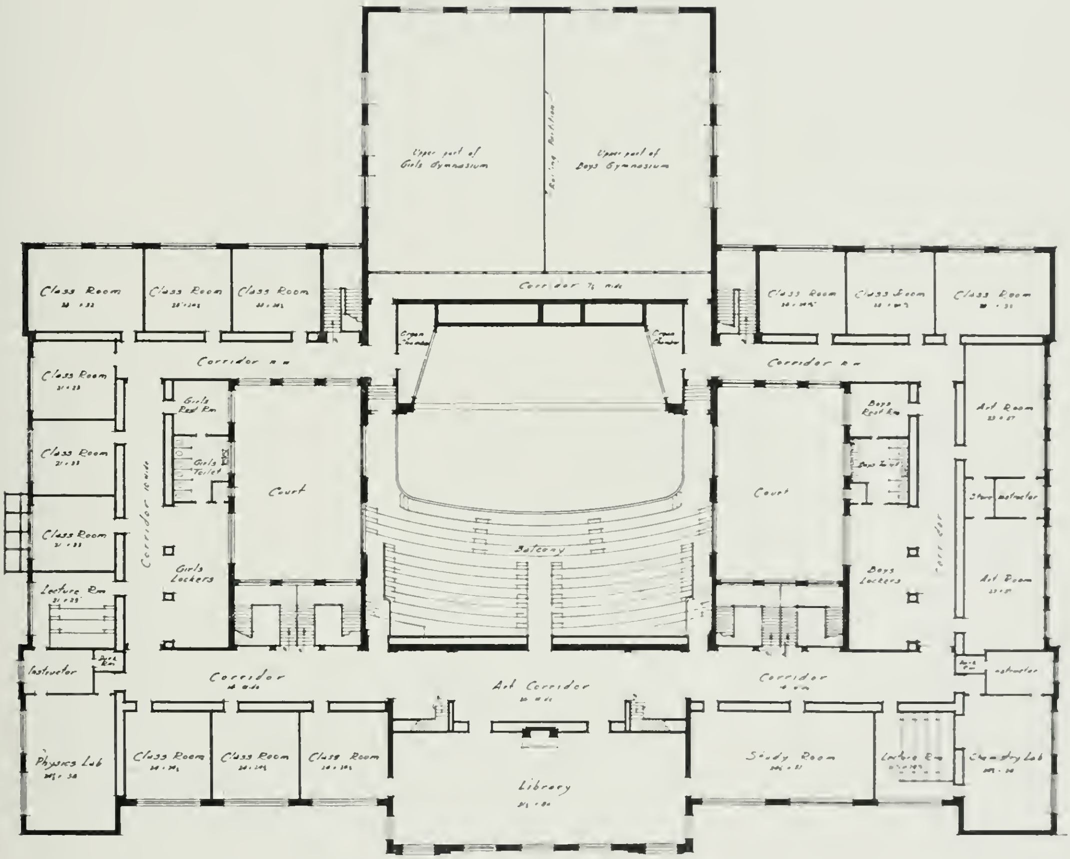
REAR VIEW, HIGH SCHOOL, SPRINGFIELD, ILL.



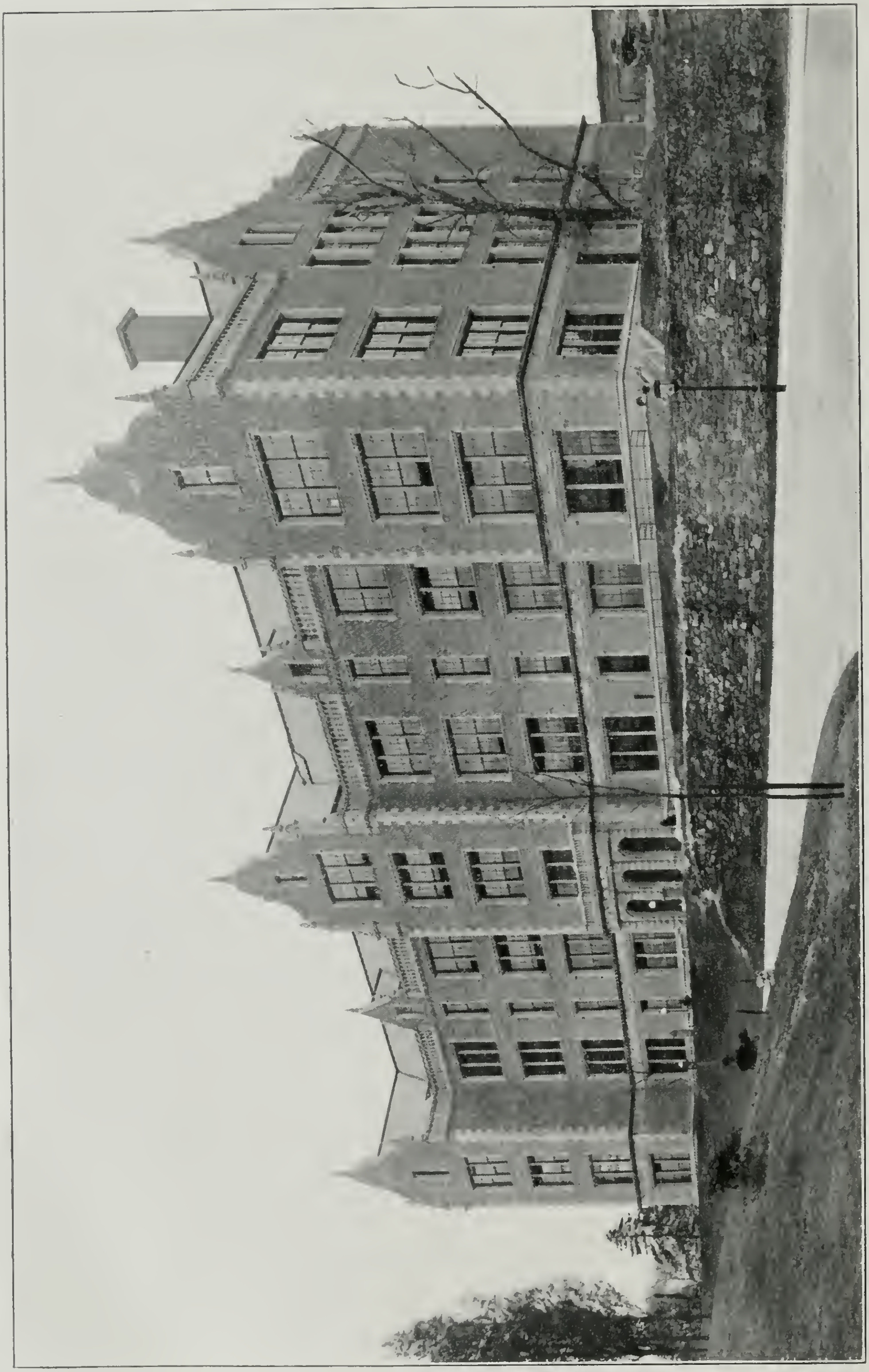
FIRST FLOOR PLAN, HIGH SCHOOL, SPRINGFIELD, ILL.



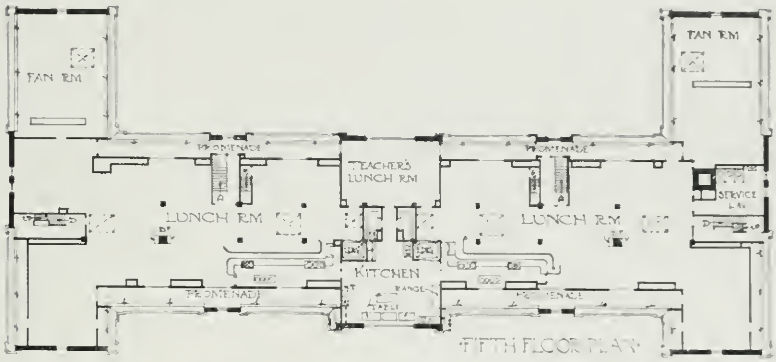
THIRD FLOOR PLAN, HIGH SCHOOL, SPRINGFIELD, ILL.

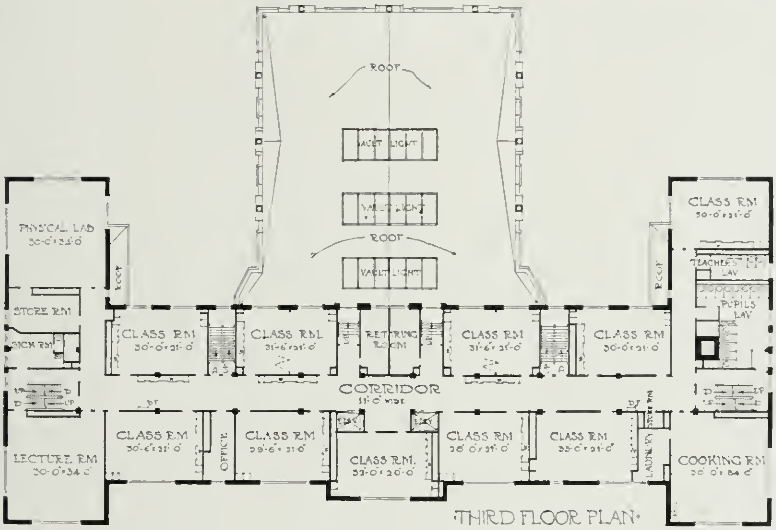


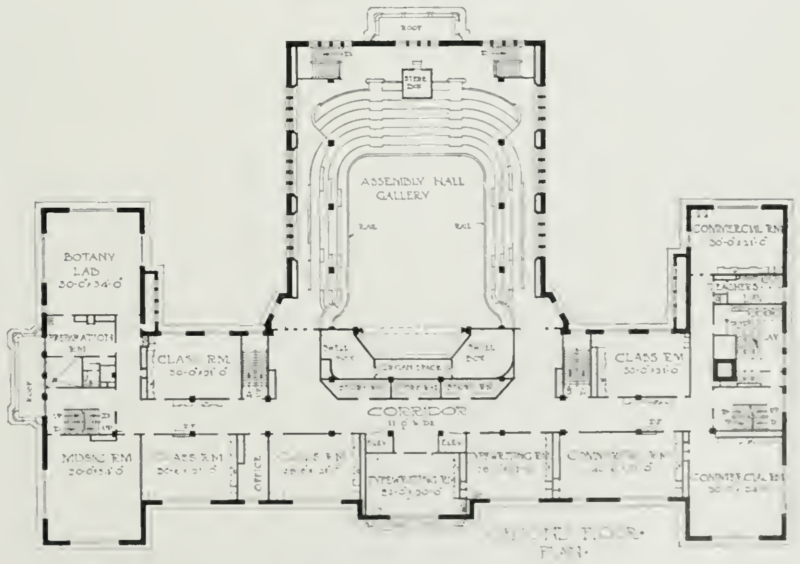
SECOND FLOOR PLAN, HIGH SCHOOL, SPRINGFIELD, ILL.



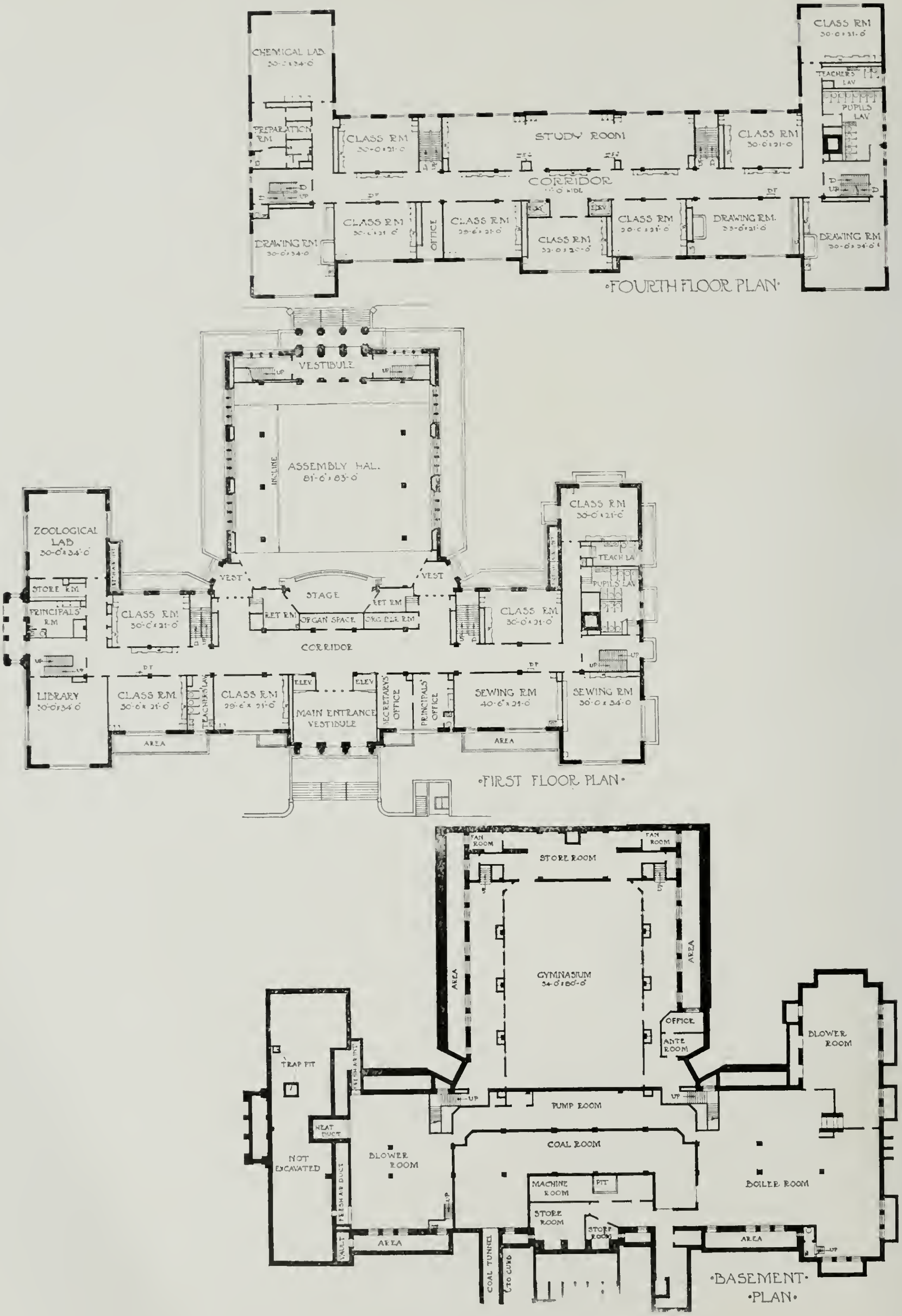
BAY RIDGE HIGH SCHOOL, NEW YORK, N. Y.
C. B. J. Snyder, Architect of the Board of Education.





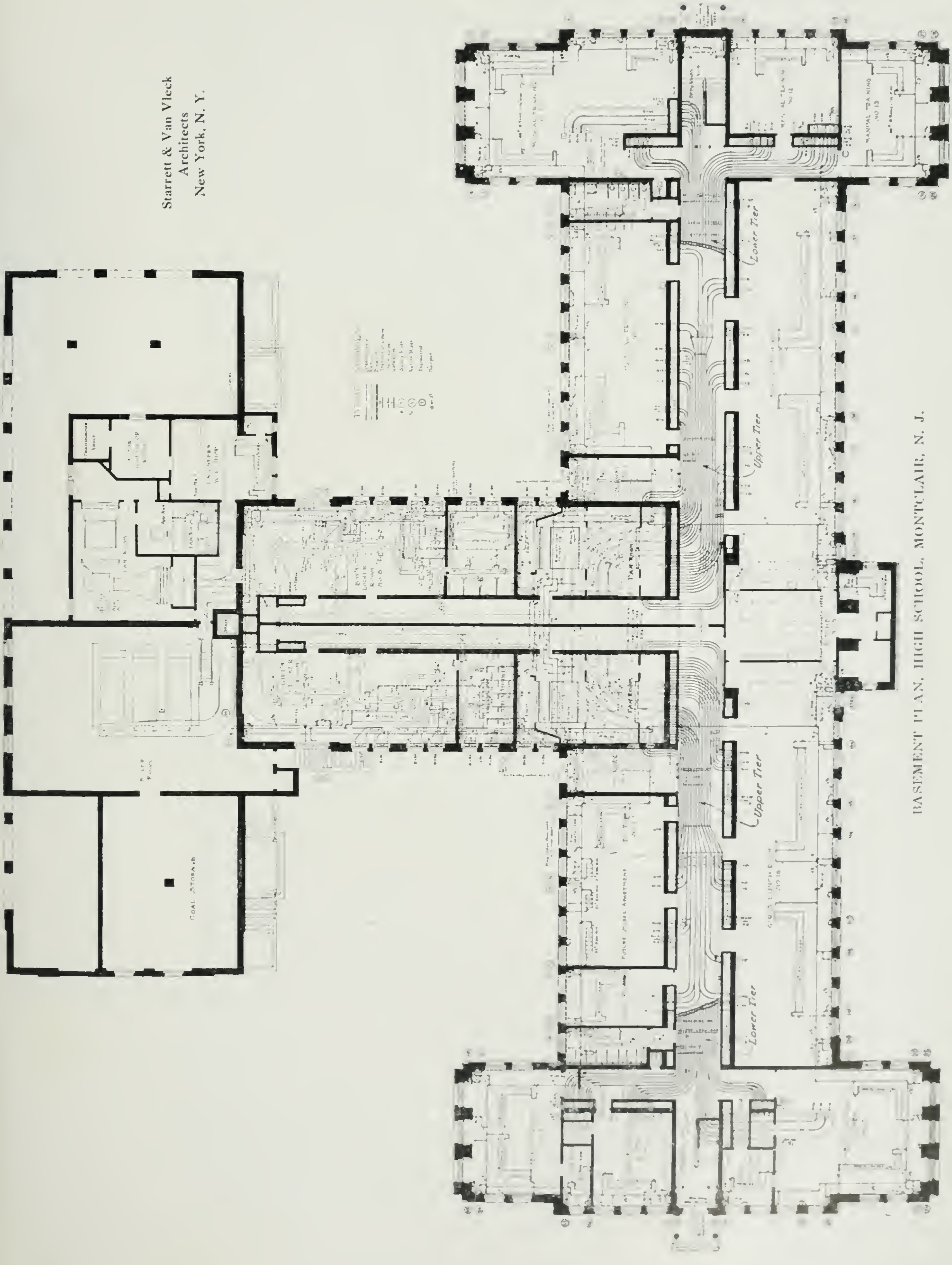


FLOOR PLANS, BAY RIDGE HIGH SCHOOL, NEW YORK, N. Y.
C. B. J. Snyder, Architect, New York, N. Y.



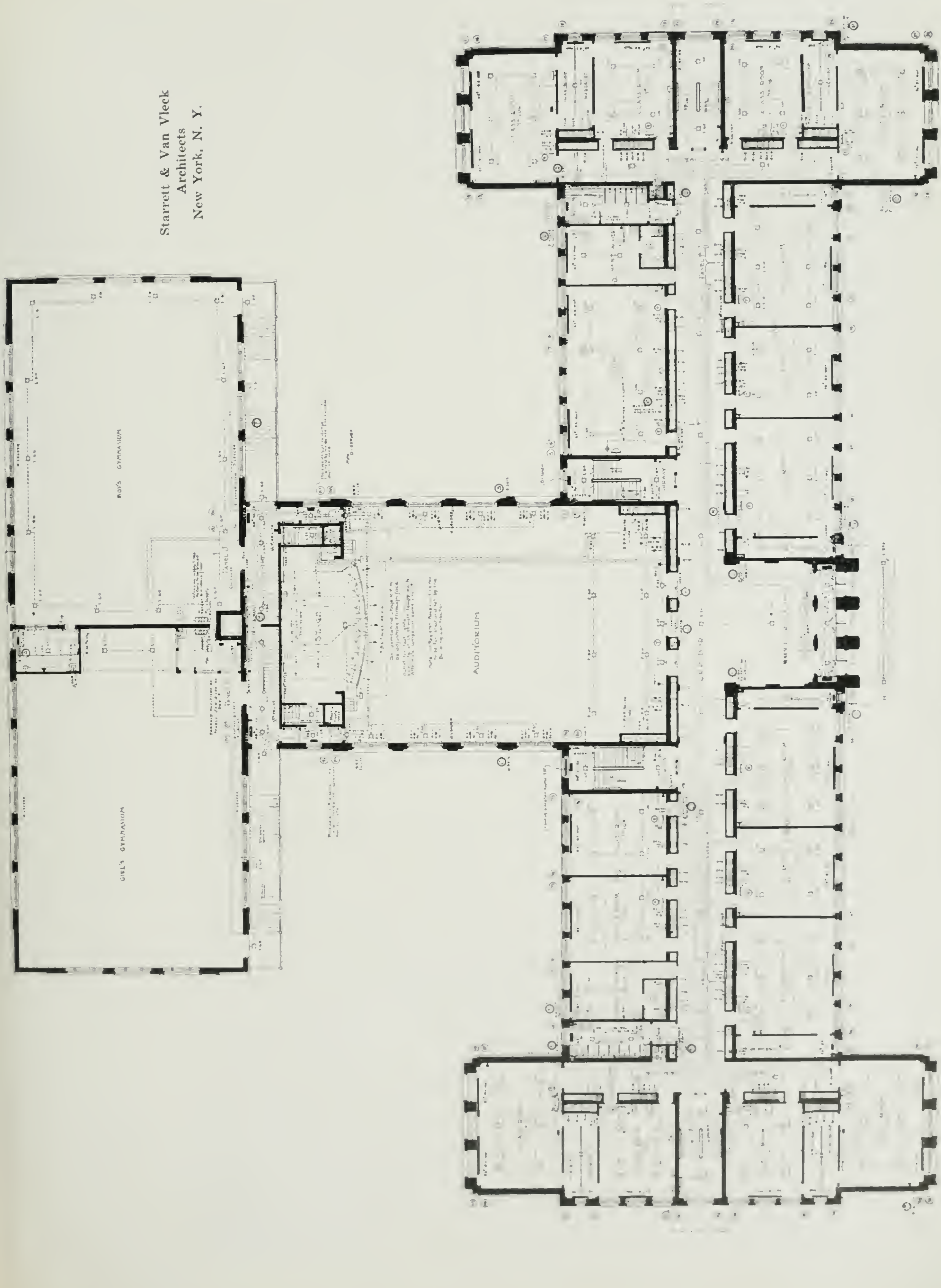
FLOOR PLANS, BAY RIDGE HIGH SCHOOL, NEW YORK, N. Y.
C. B. J. Snyder, Architect, New York, N. Y.

Starrett & Van Vleck
Architects
New York, N. Y.



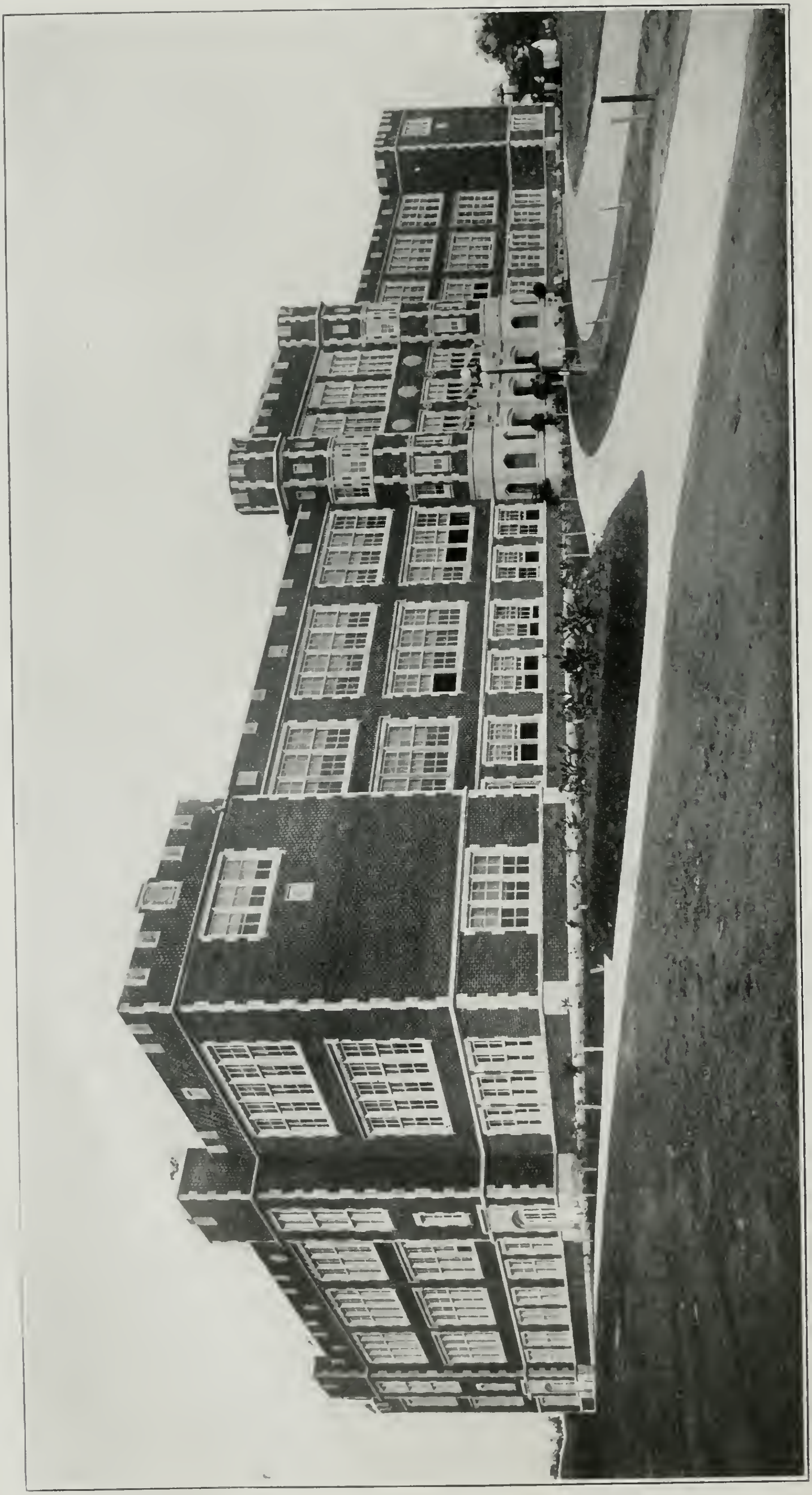
BASEMENT PLAN, HIGH SCHOOL, MONTCLAIR, N. J.

THE MONTCLAIR HIGH SCHOOL, MONTCLAIR, N. J.
Starrett & Van Vleck, Architects, New York, N. Y.



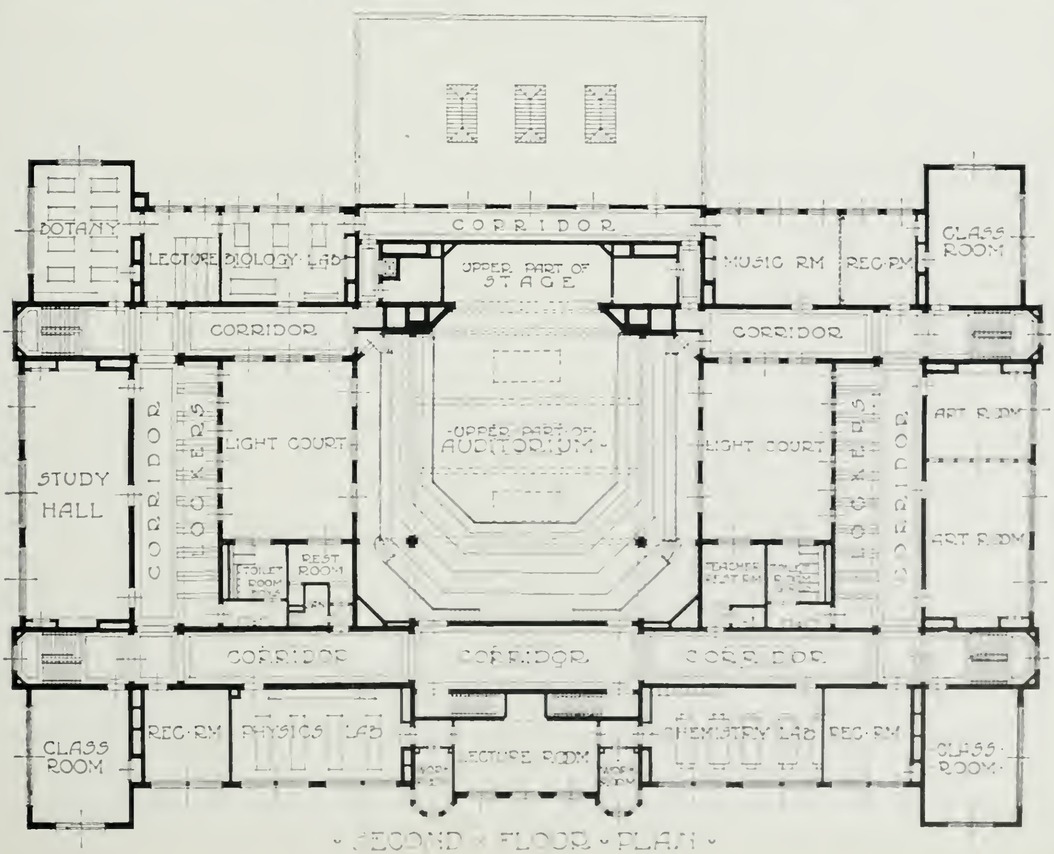
Starrett & Van Vleck
Architects
New York, N. Y.

FIRST FLOOR PLAN, MONTCLAIR HIGH SCHOOL, MONTCLAIR, N. J.

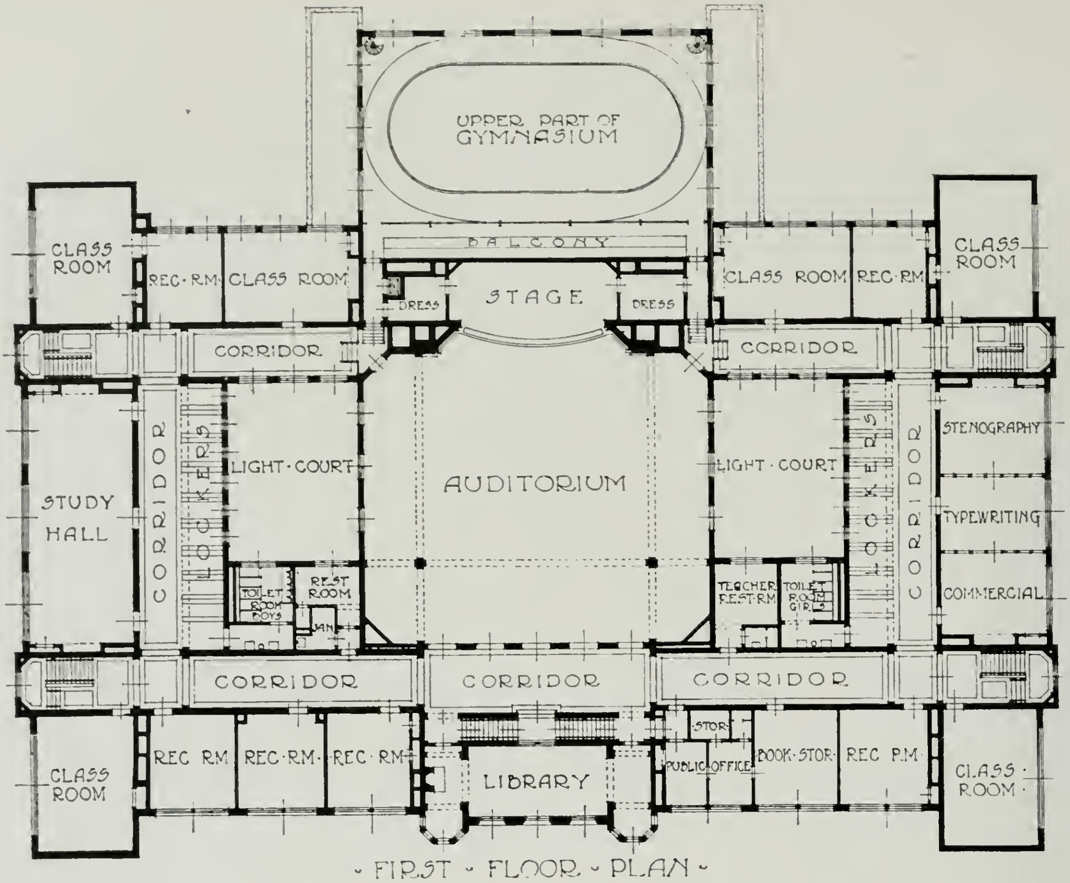


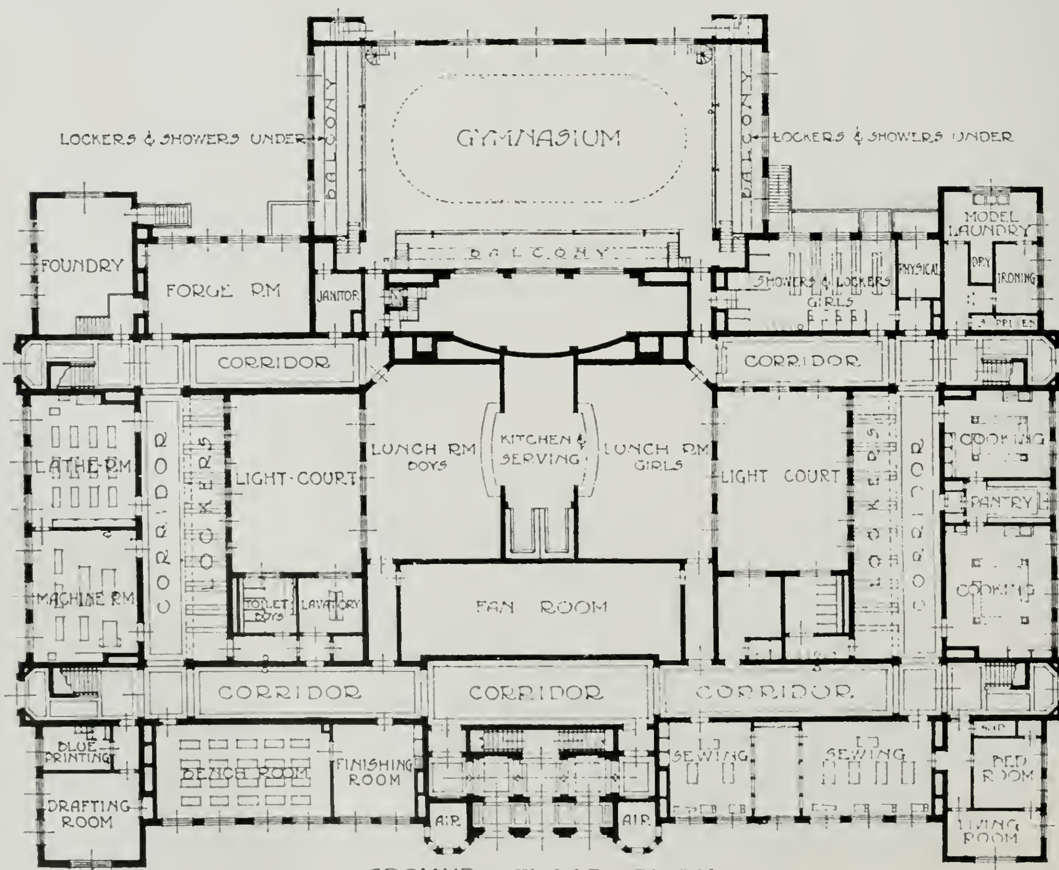
PARKERSBURG HIGH SCHOOL, PARKERSBURG, W. VA.
Frank L. Packard, Architect, Columbus, O.

AUDITORIUM, PARKERSBURG HIGH SCHOOL, PARKERSBURG, W. VA.

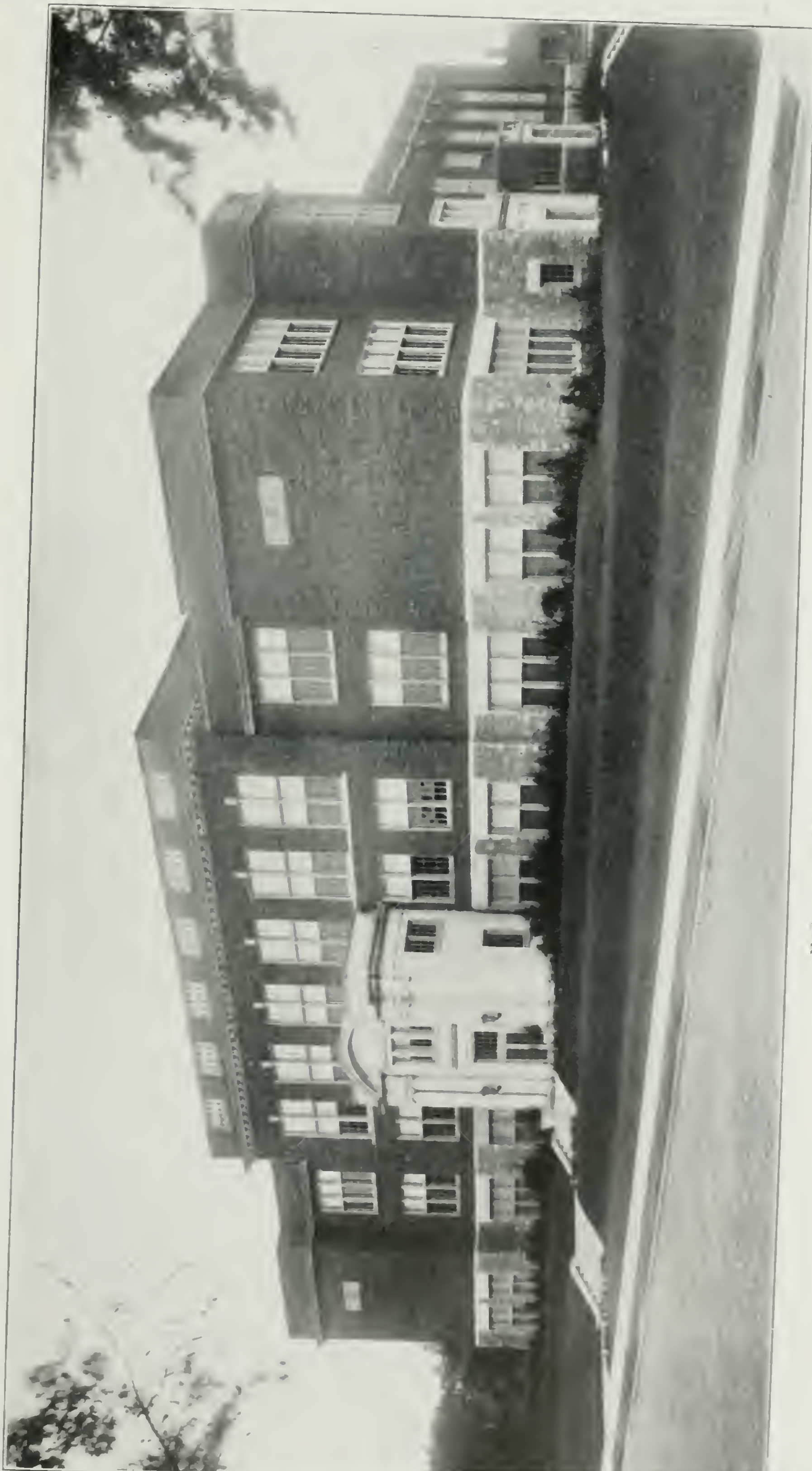


SECOND FLOOR PLAN

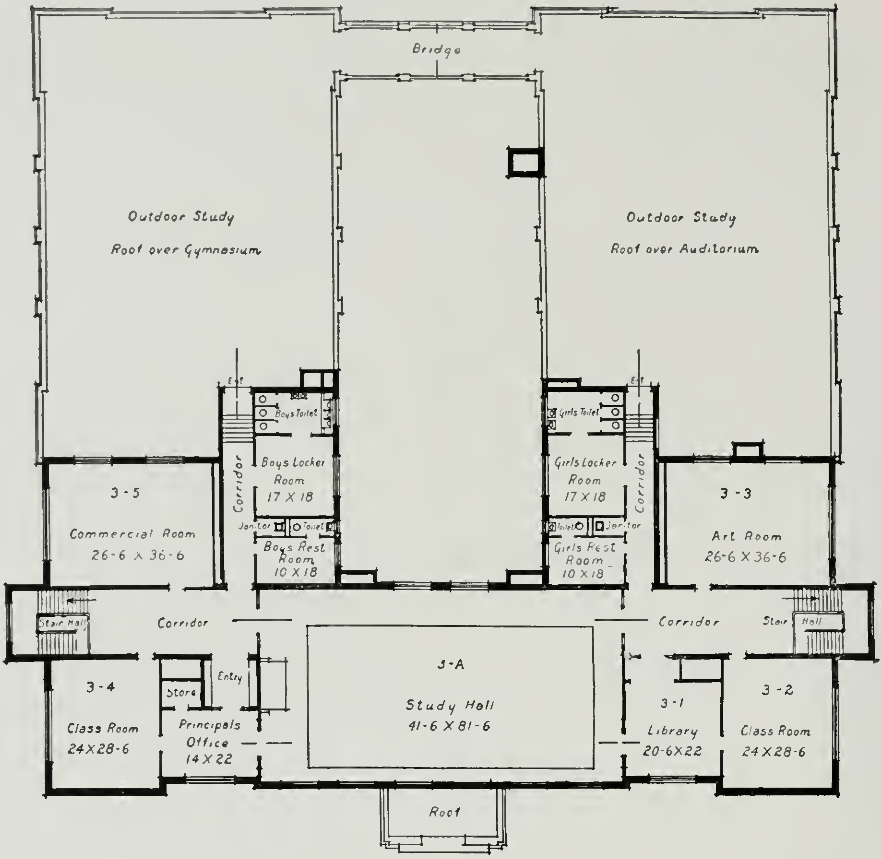




FLOOR PLANS, PARKERSBURG HIGH SCHOOL, PARKERSBURG, W. VA.



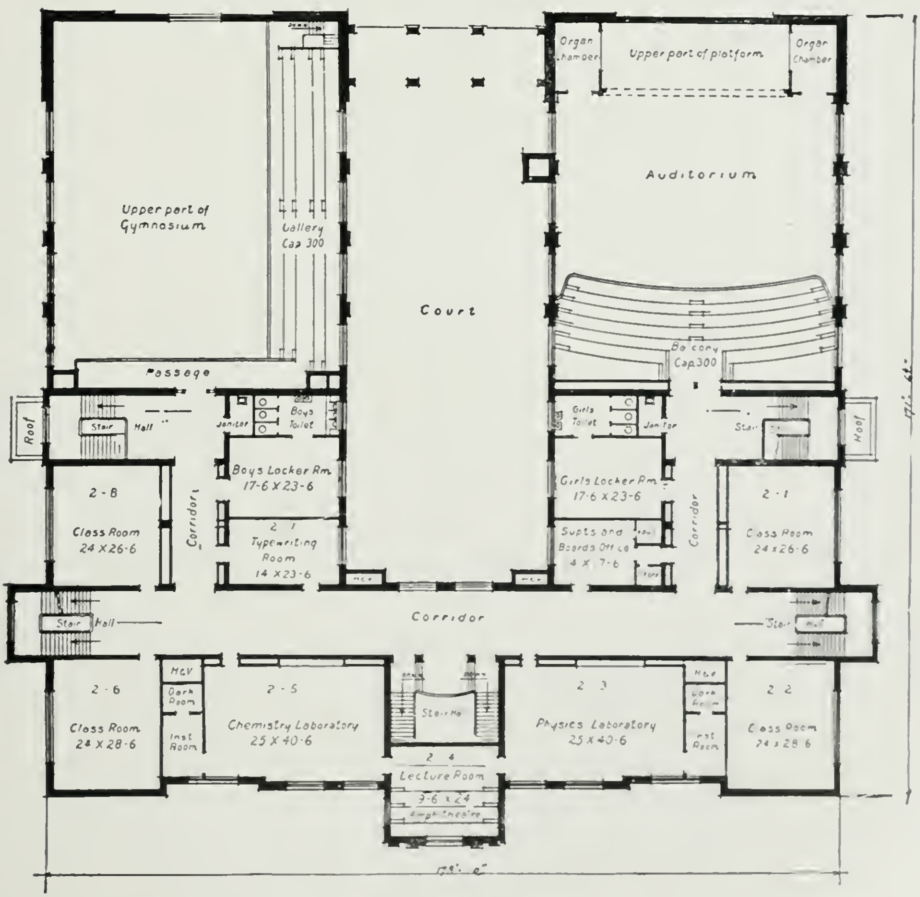
McCLAIN HIGH SCHOOL, GREENFIELD, O.
Wm. B. Ittner, Architect, St. Louis, Mo.



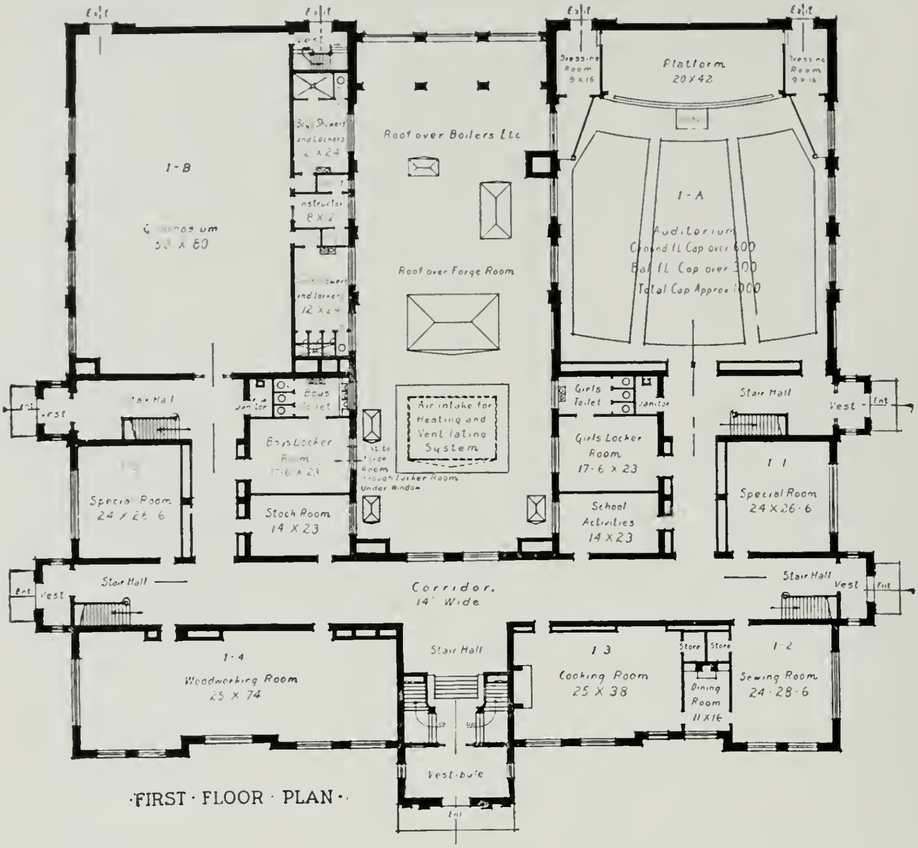
·THIRD · FLOOR · PLAN·

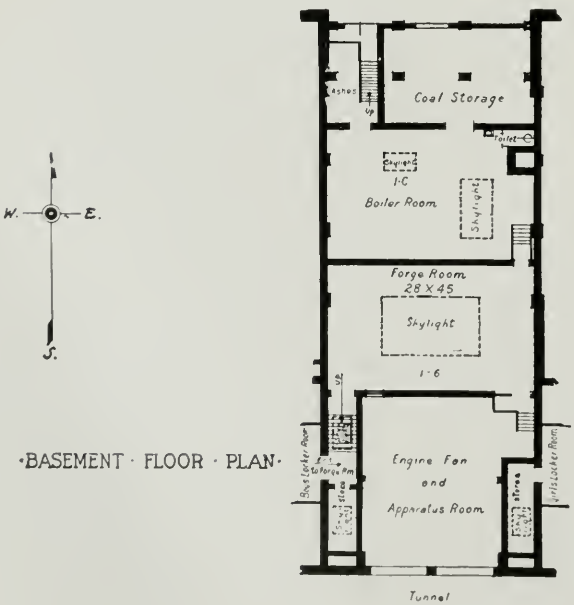
COOKING ROOM, McCLAIN HIGH SCHOOL, GREENFIELD, O.

ASSEMBLY HALL, McCLAIN HIGH SCHOOL, GREENFIELD, O.



·SECOND·FLOOR·PLAN·



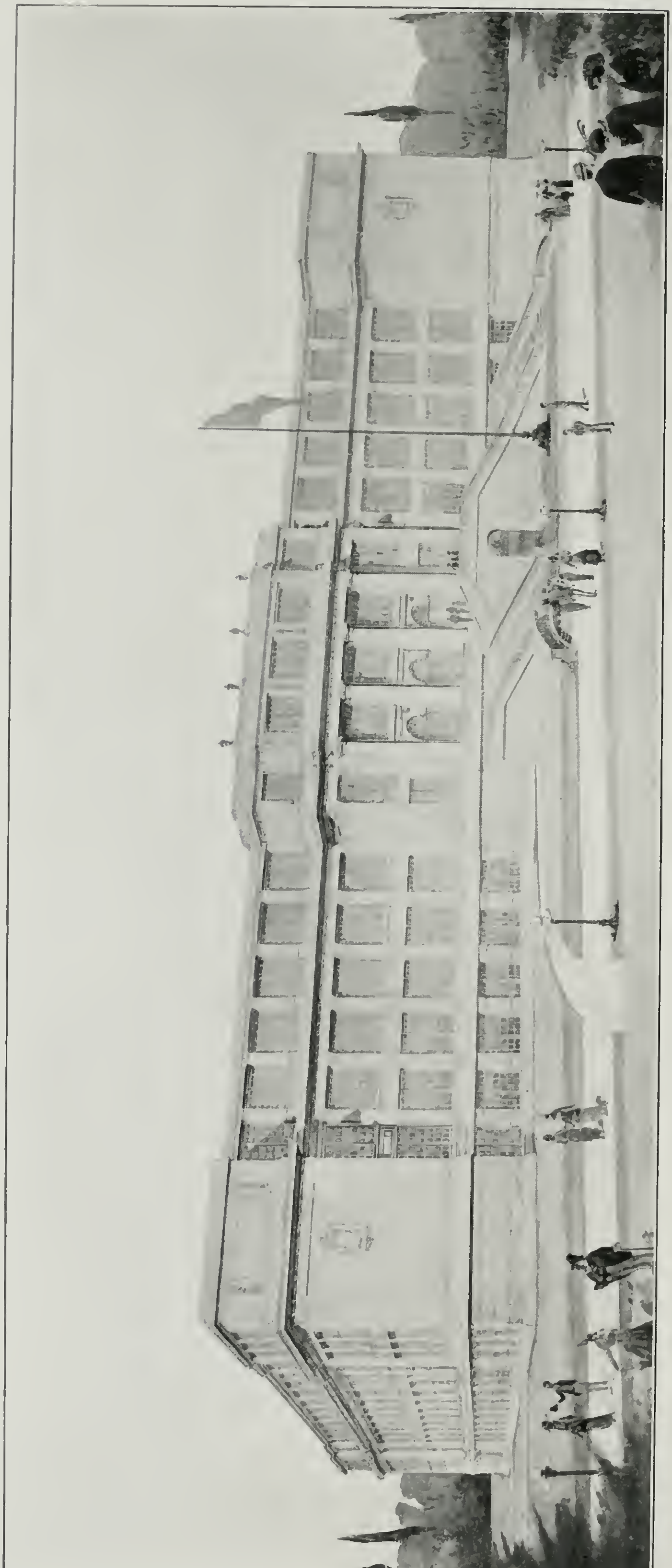


FLOOR PLANS, McCLAIN HIGH SCHOOL, GREENFIELD, O.

Wm. B. Ittner, Architect, St. Louis Mo.

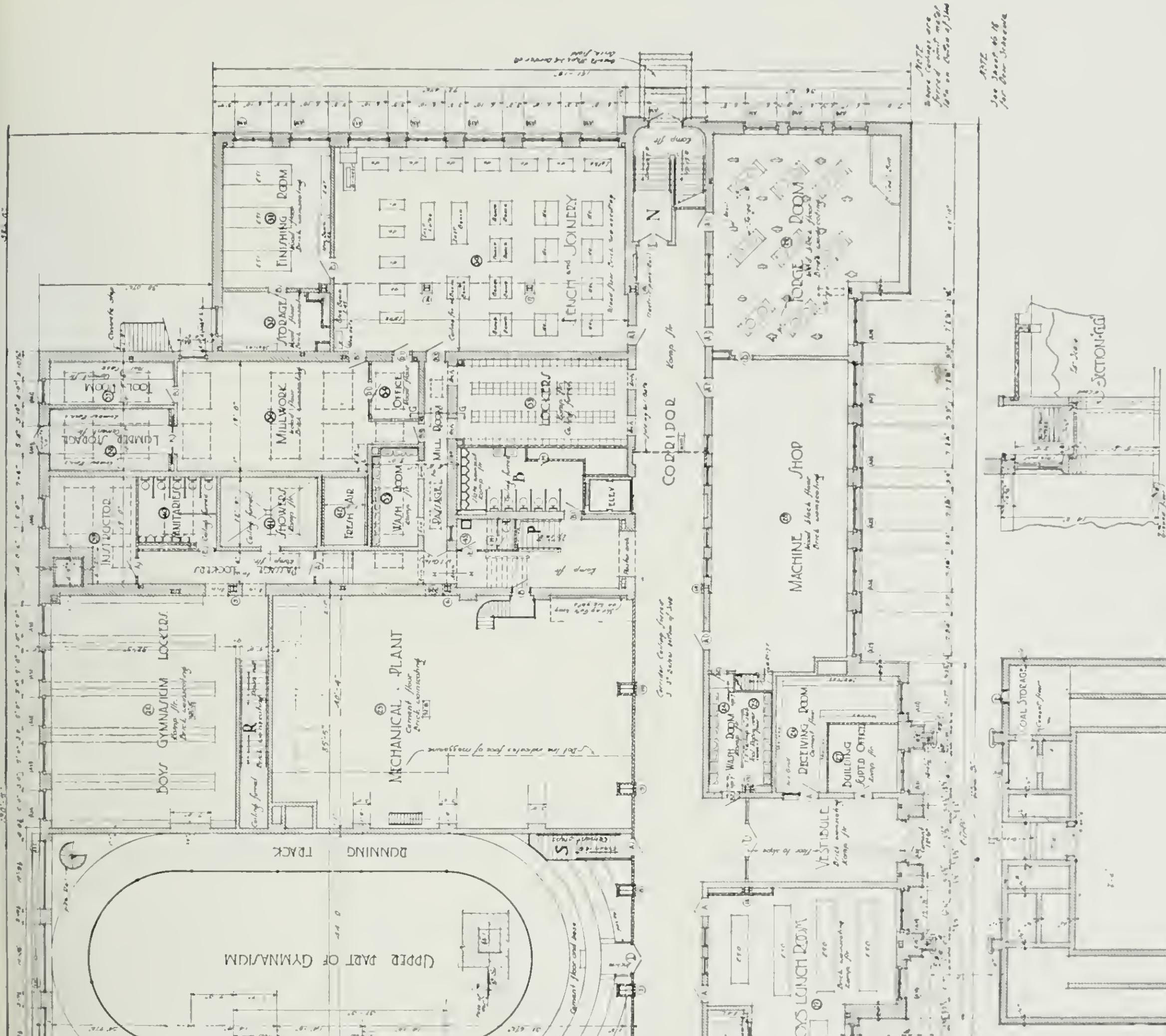
VIEW FROM PLAYGROUND, McCLAIN HIGH SCHOOL, GREENFIELD, O.

Wm. B. Ittner, Architect, St. Louis, Mo.

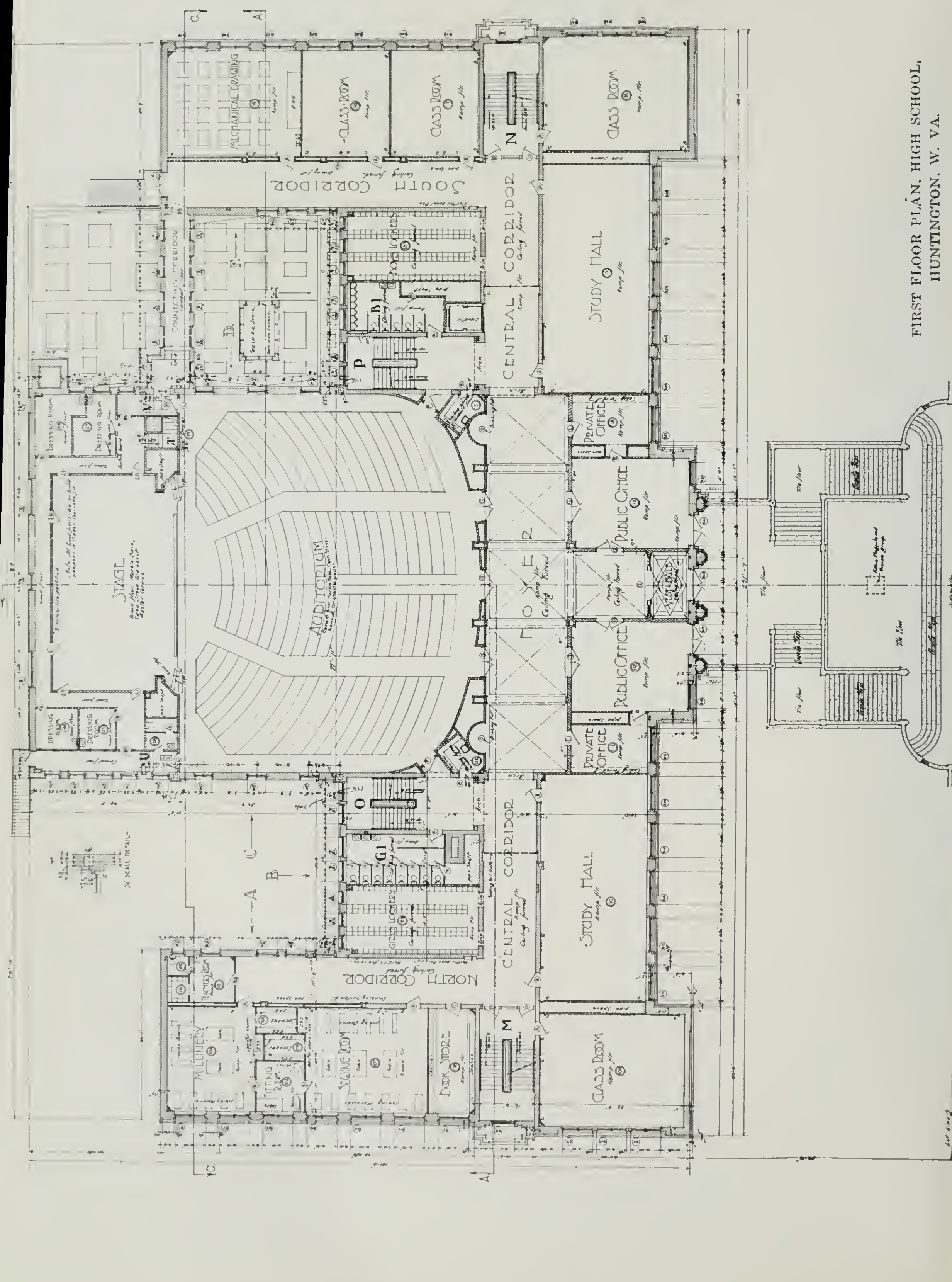


ARCHITECT'S PERSPECTIVE, HIGH SCHOOL, HUNTINGTON, W. VA.

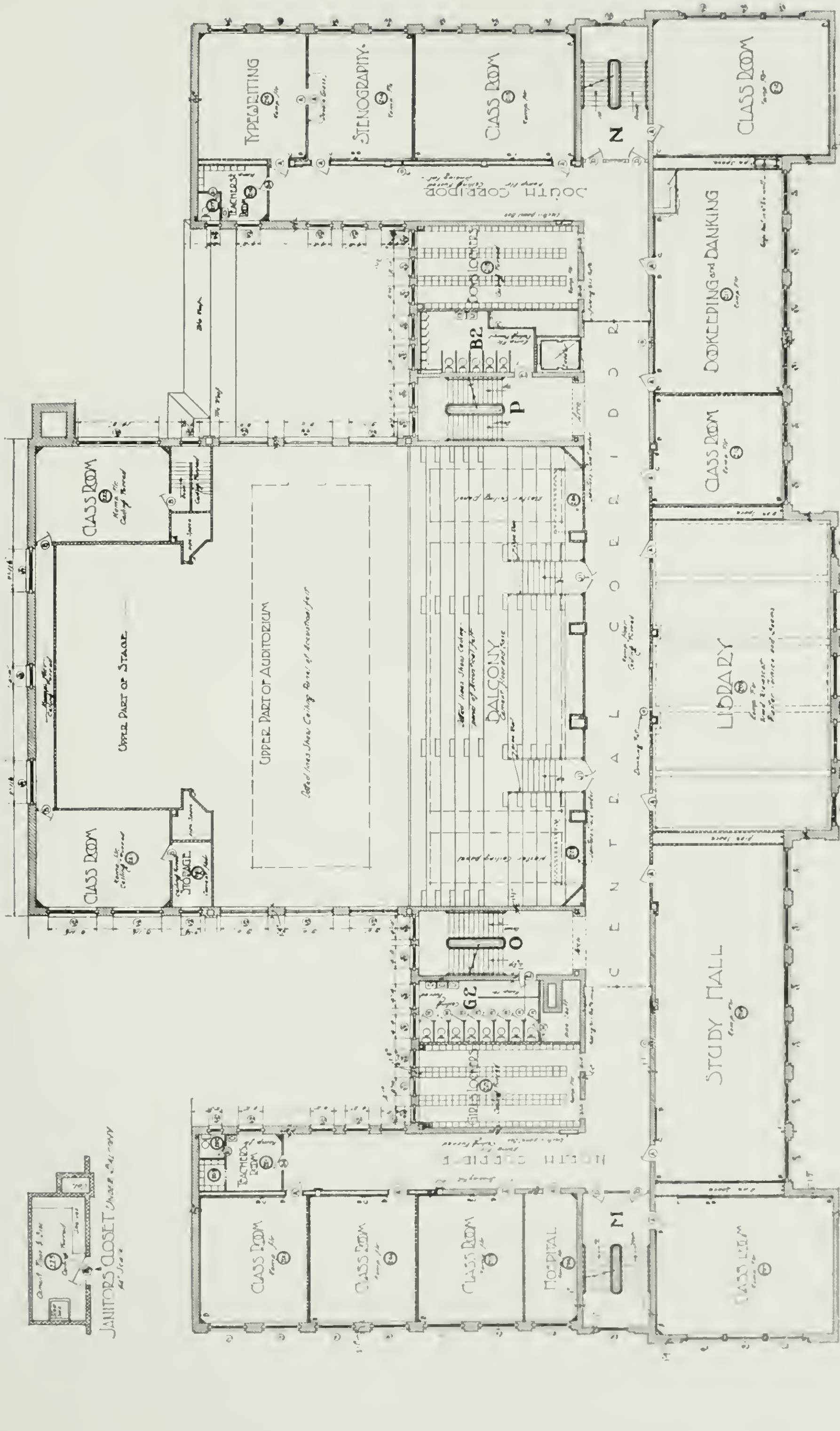
Verus T Ritter, Architect, Huntington, W. Va.



GROUND FLOOR, HIGH SCHOOL, HUNTINGTON, W. VA.



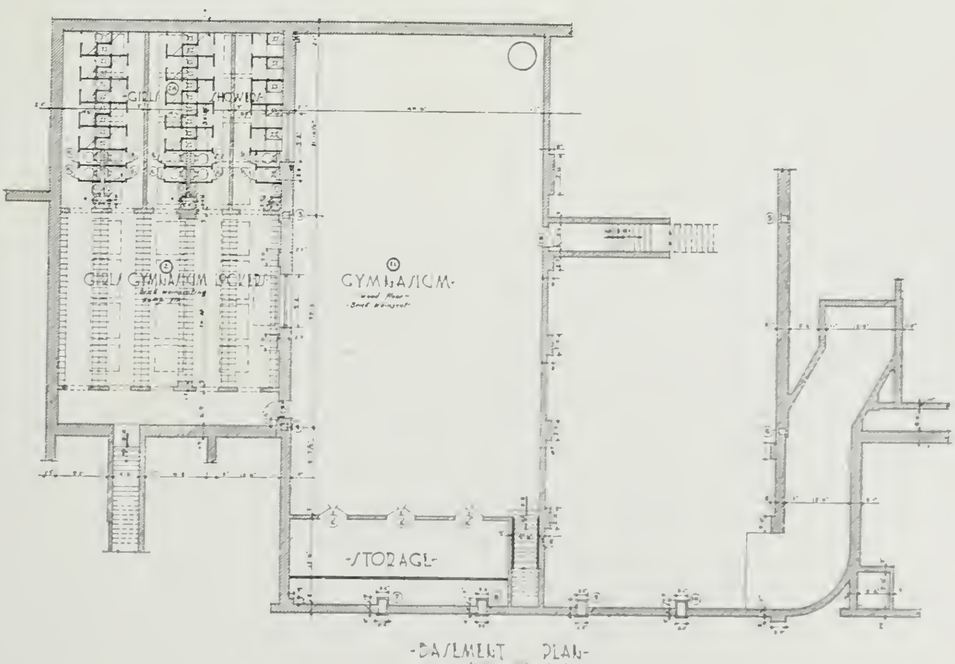
FIRST FLOOR PLAN, HIGH SCHOOL, HUNTINGTON, W. VA.



SECOND FLOOR PLAN, HIGH SCHOOL, HUNTINGTON, W. VA.

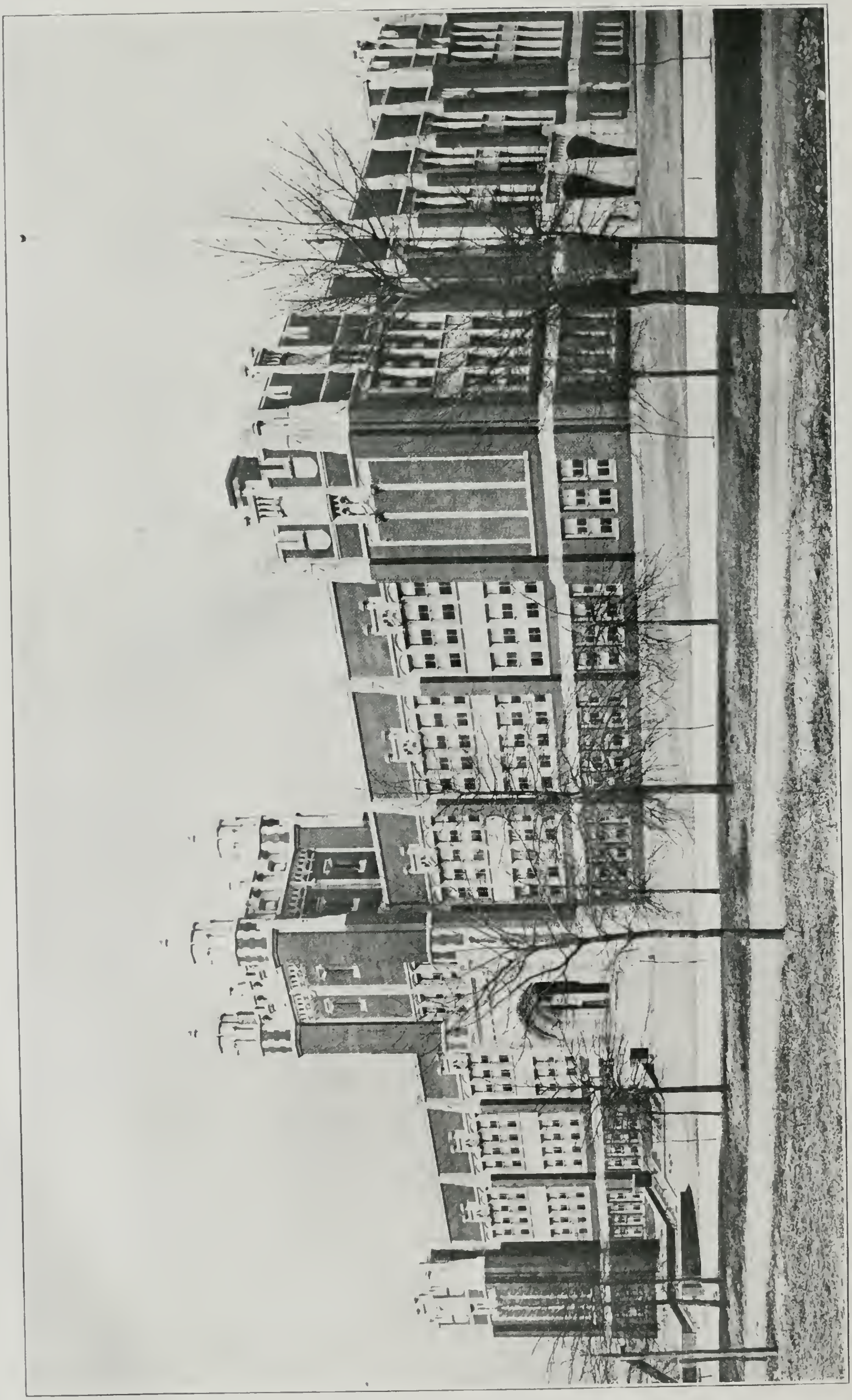
THIRD FLOOR PLAN, HIGH SCHOOL, HUNTINGTON, W. VA.

DETAIL, HIGH SCHOOL, HUNTINGTON, W. VA.

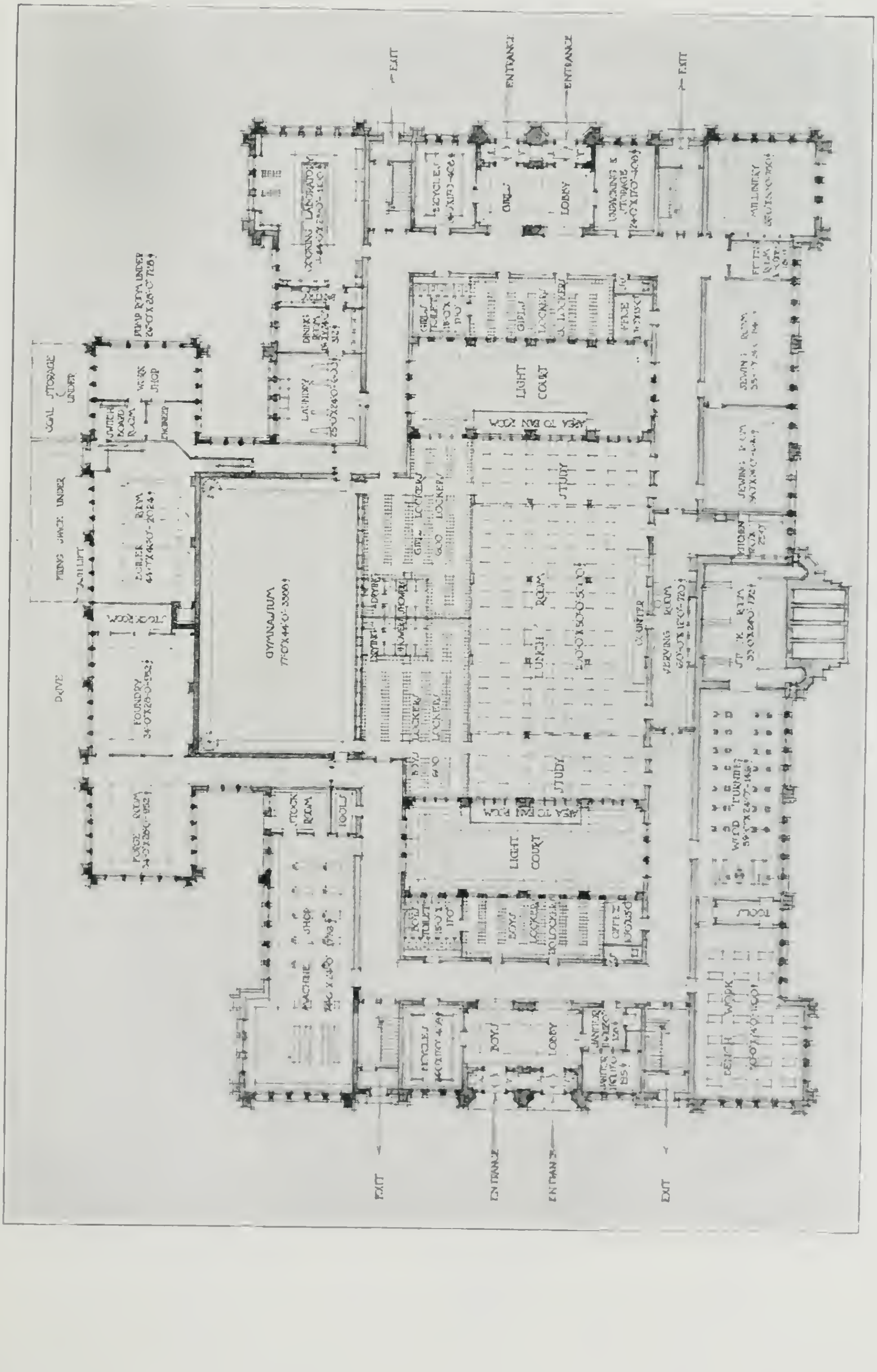


BASEMENT PLAN, HIGH SCHOOL, HUNTINGTON, W. VA.

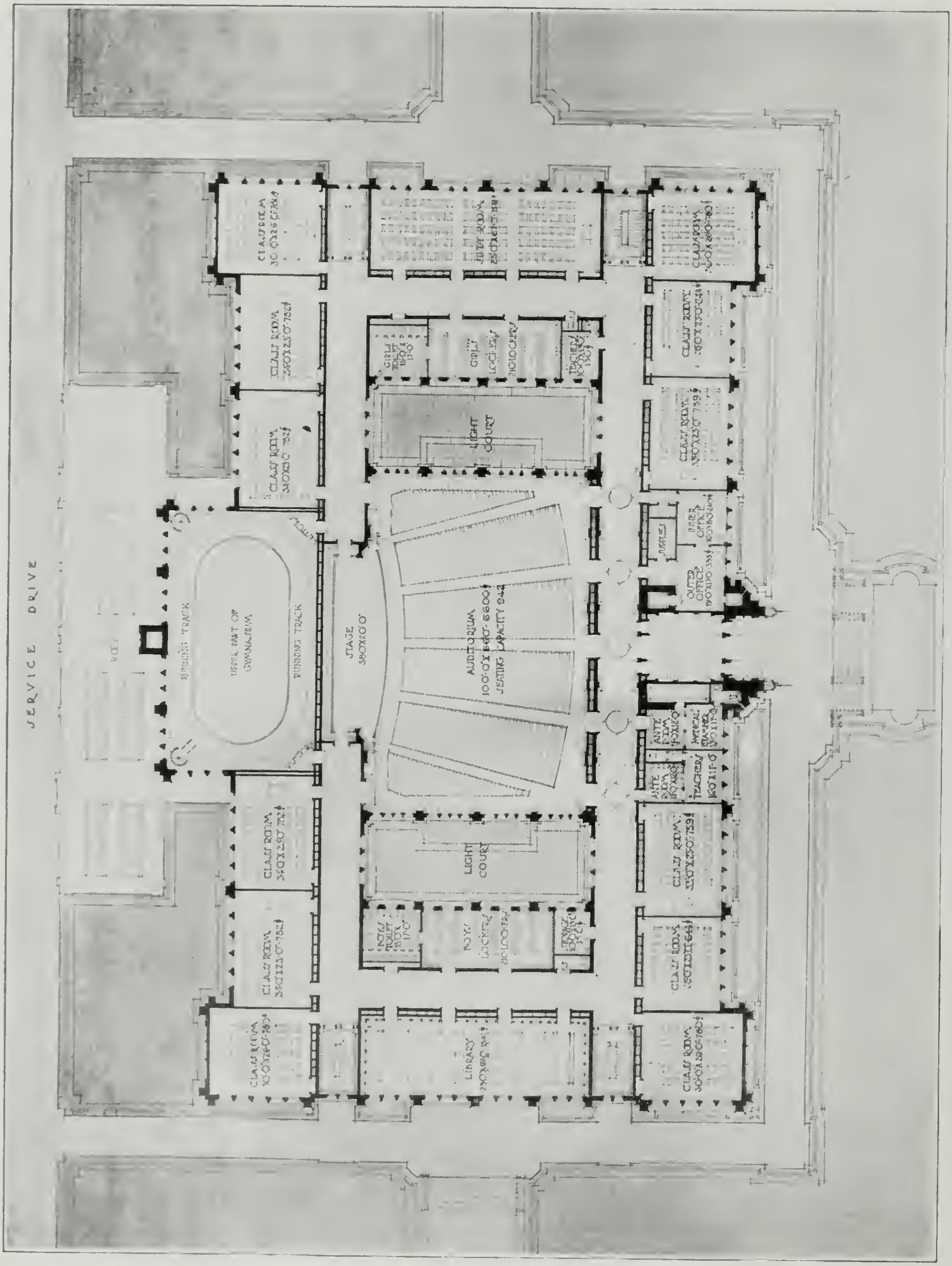
Verus T. Ritter, Architect, Huntington, W. Va.



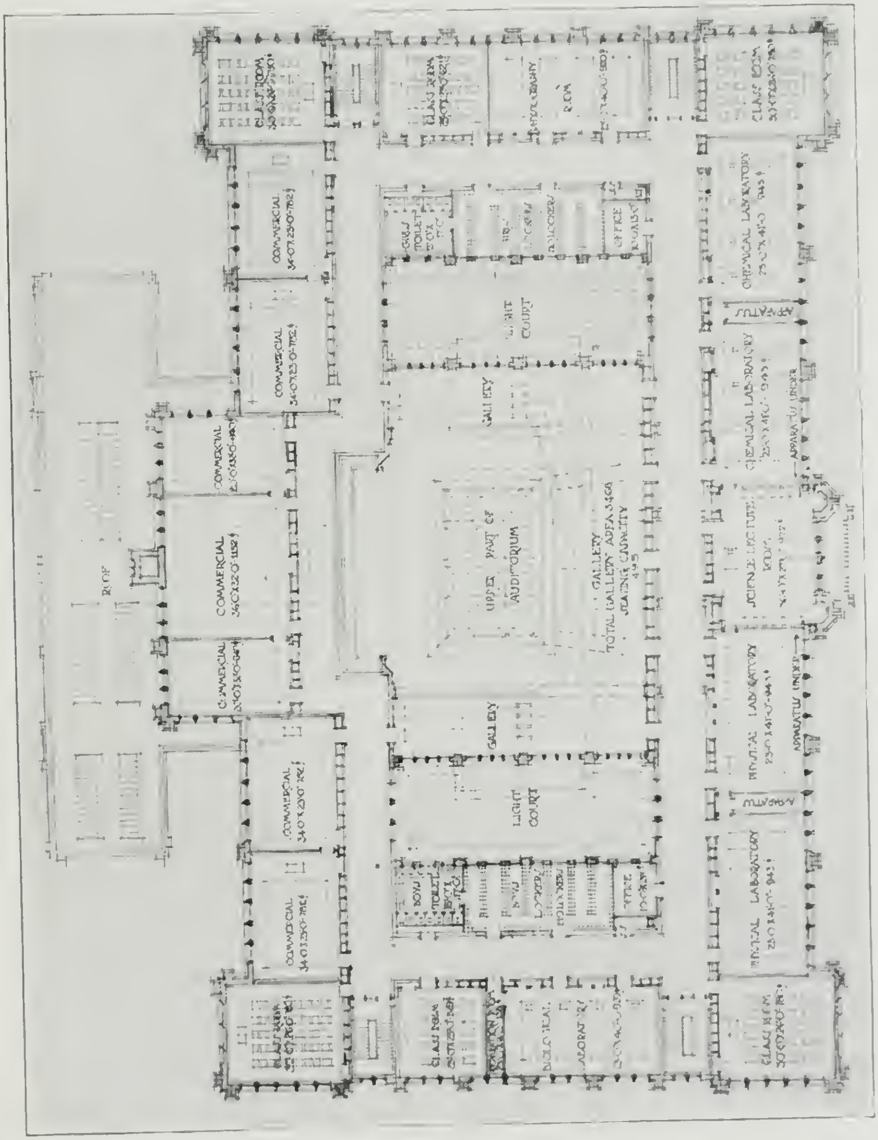
CAMDEN HIGH SCHOOL, CAMDEN, N. J.
Paul A. Davis, Architect, Philadelphia, Pa.



GROUND FLOOR PLAN, CAMDEN HIGH SCHOOL, CAMDEN, N. J.



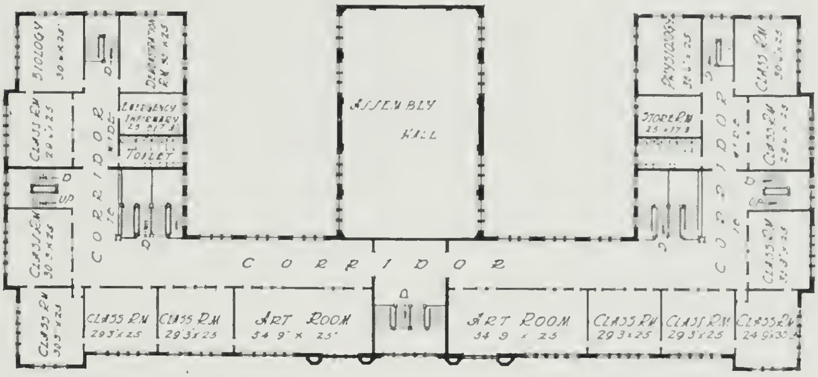
FIRST FLOOR PLAN, CAMDEN HIGH SCHOOL, CAMDEN, N. J.

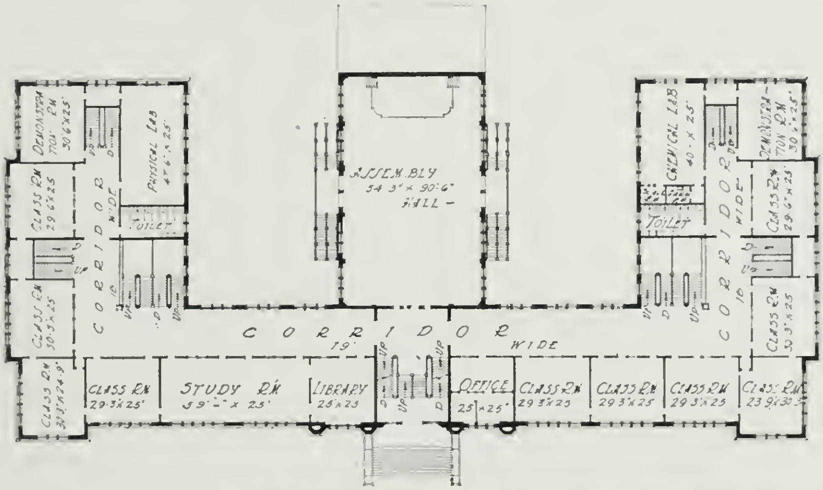


SECOND FLOOR PLAN, CAMDEN HIGH SCHOOL, CAMDEN, N. J.
Paul A. Davis, Architect, Philadelphia, Pa.

ESPLANADE AVENUE HIGH SCHOOL, NEW ORLEANS, LA.
E. A. Christy, Municipal Architect, New Orleans.

SECOND FLOOR PLAN.

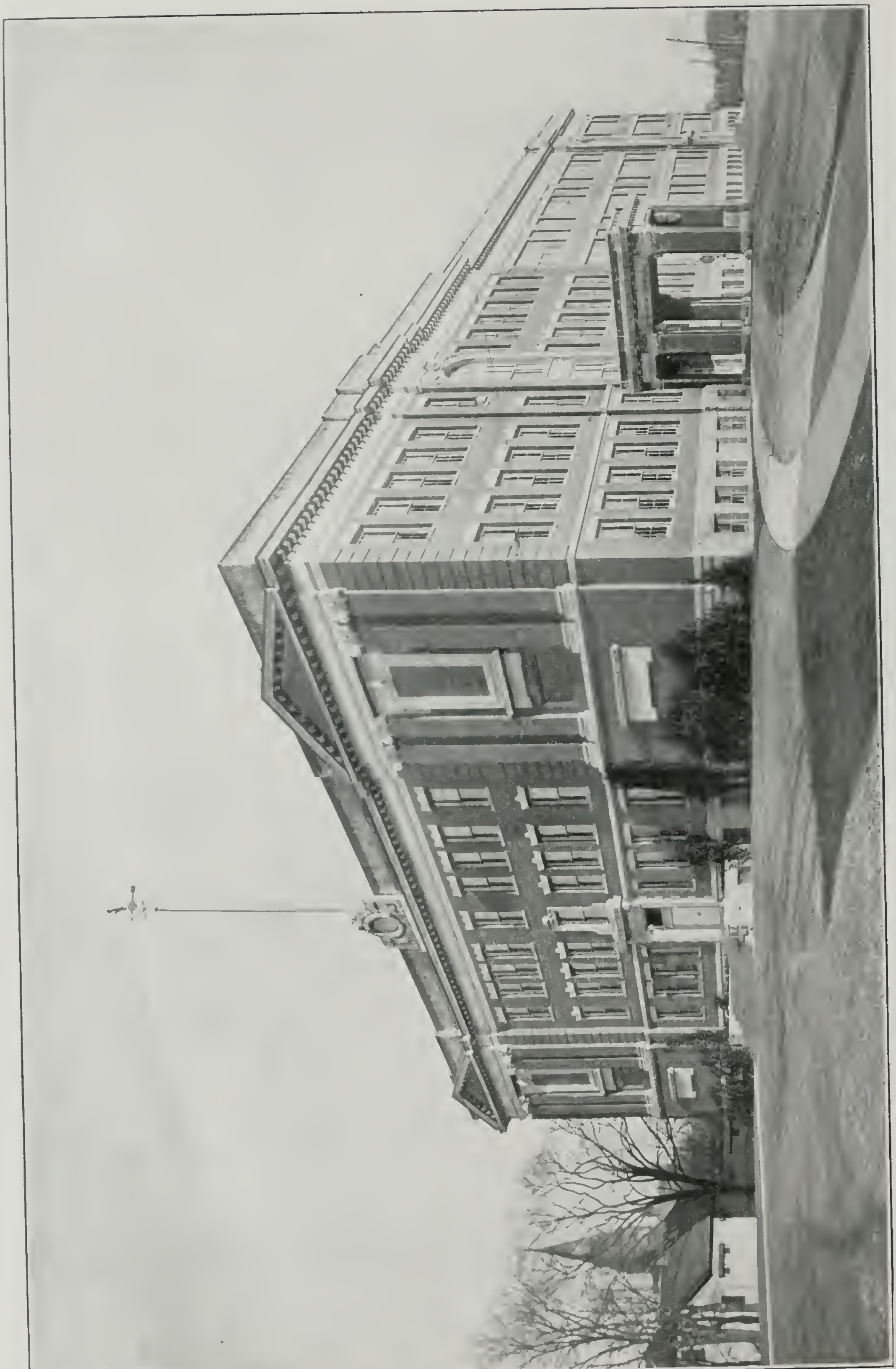




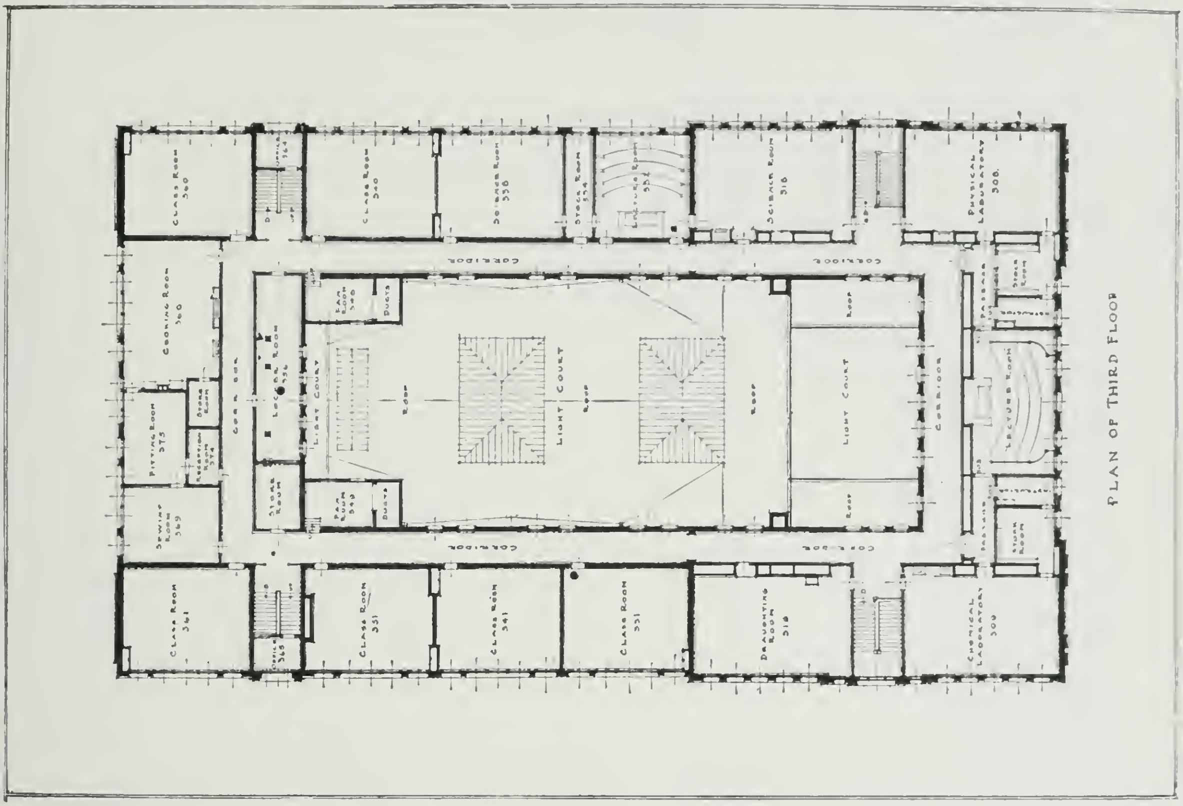
FIRST FLOOR PLAN.

ASSEMBLY ROOM

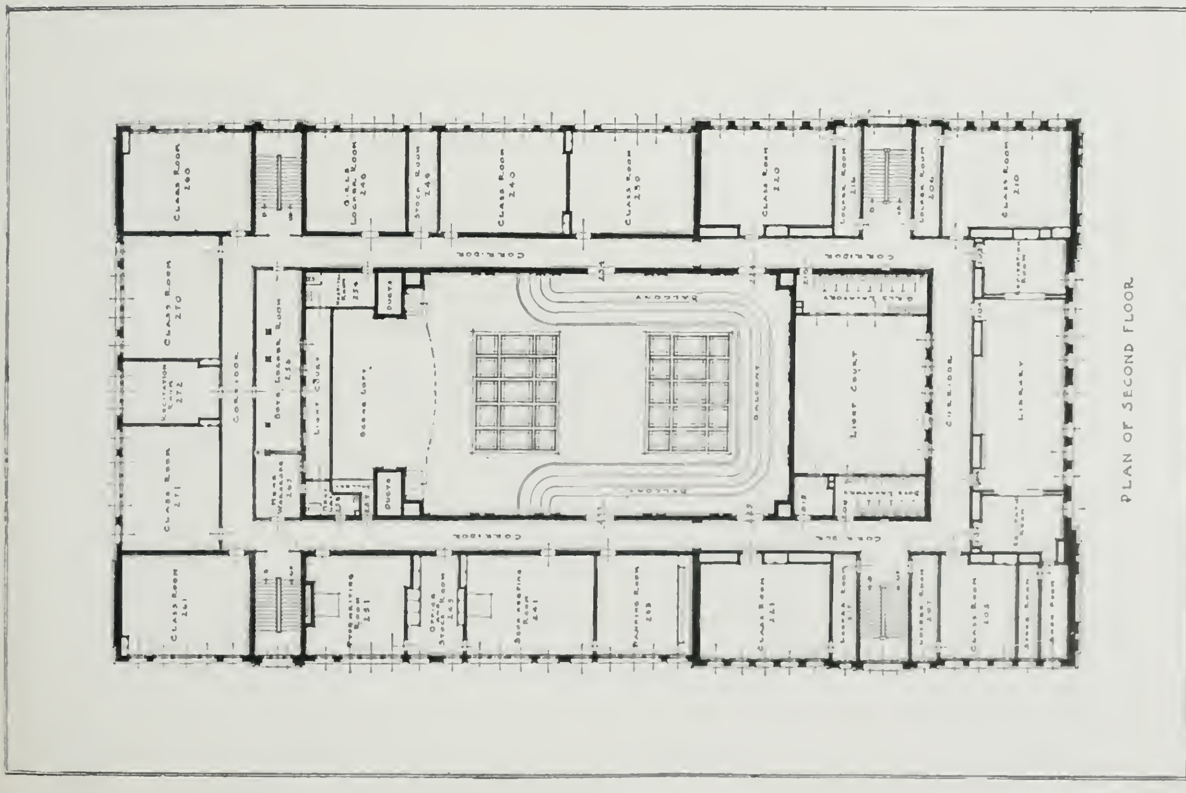
ESPLANADE AVENUE HIGH SCHOOL, NEW ORLEANS, LA.



PLAINFIELD HIGH SCHOOL, PLAINFIELD, N. J.
Wilder & White, Architects, New York, N. Y.

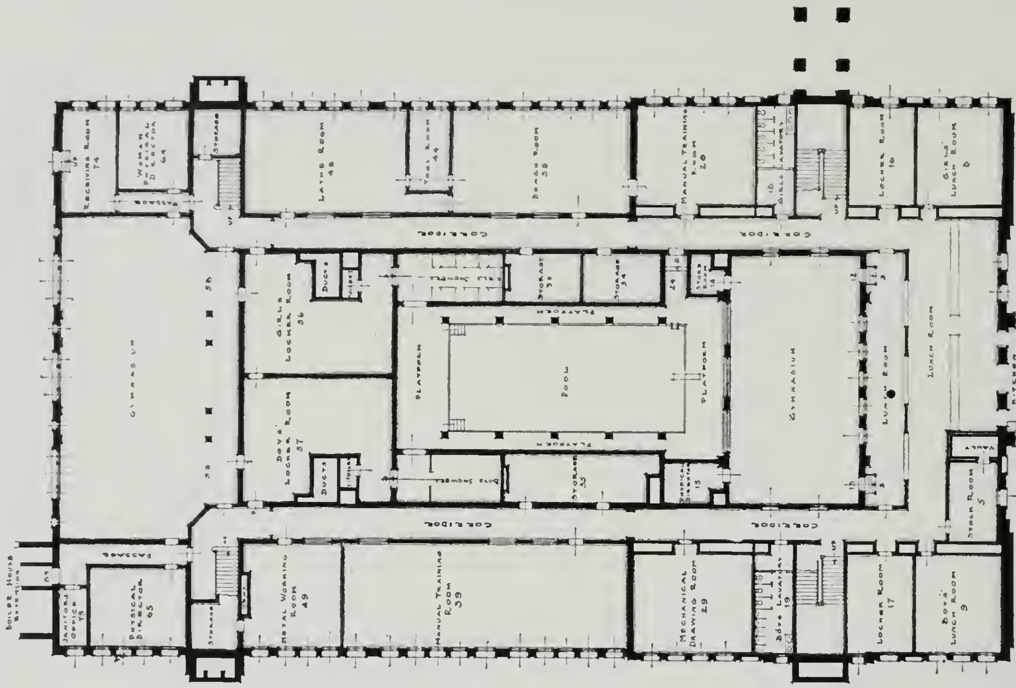


PLAN OF THIRD FLOOR

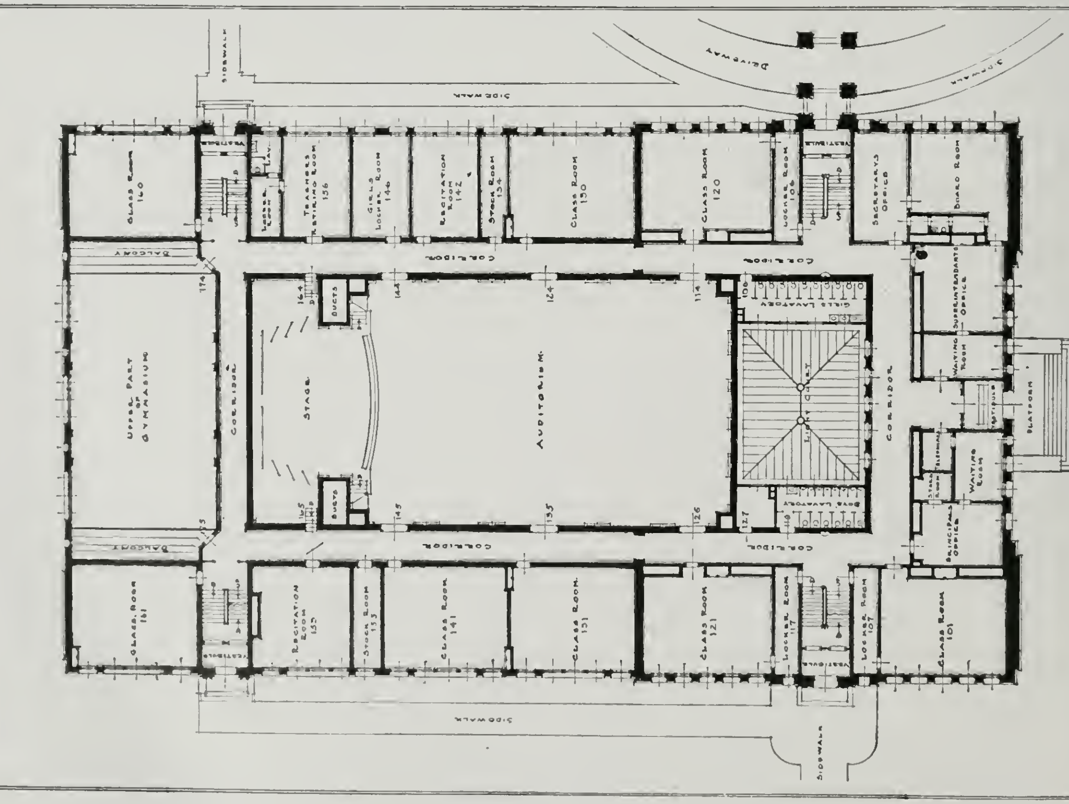


PLAN OF SECOND FLOOR

PLAINFIELD HIGH SCHOOL, PLAINFIELD, N. J.



PLAN OF BASEMENT

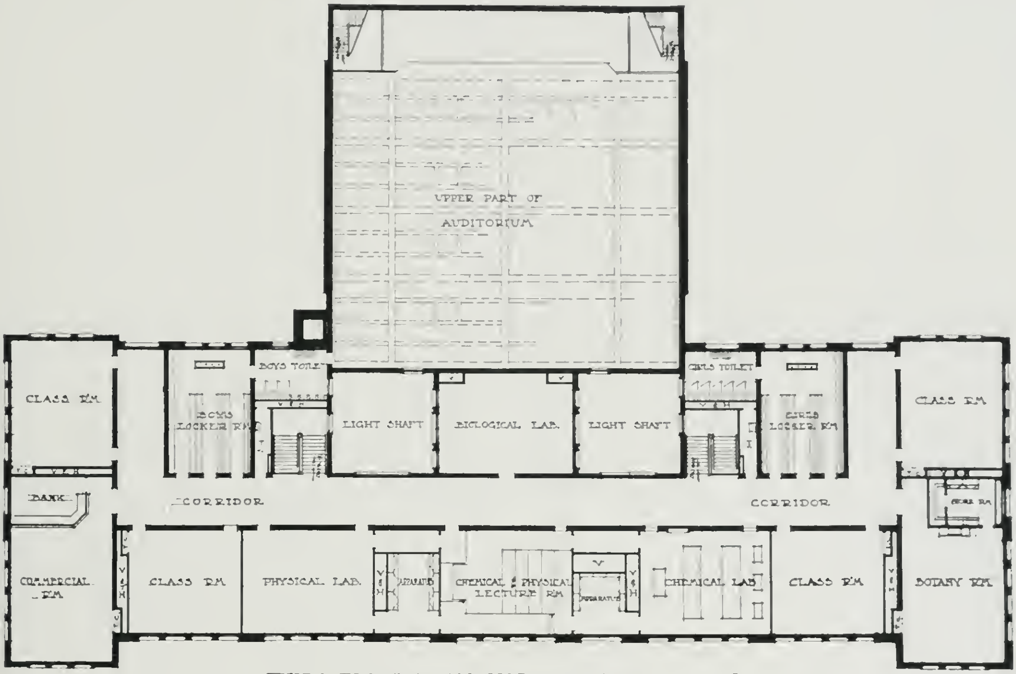


PLAN OF FIRST FLOOR

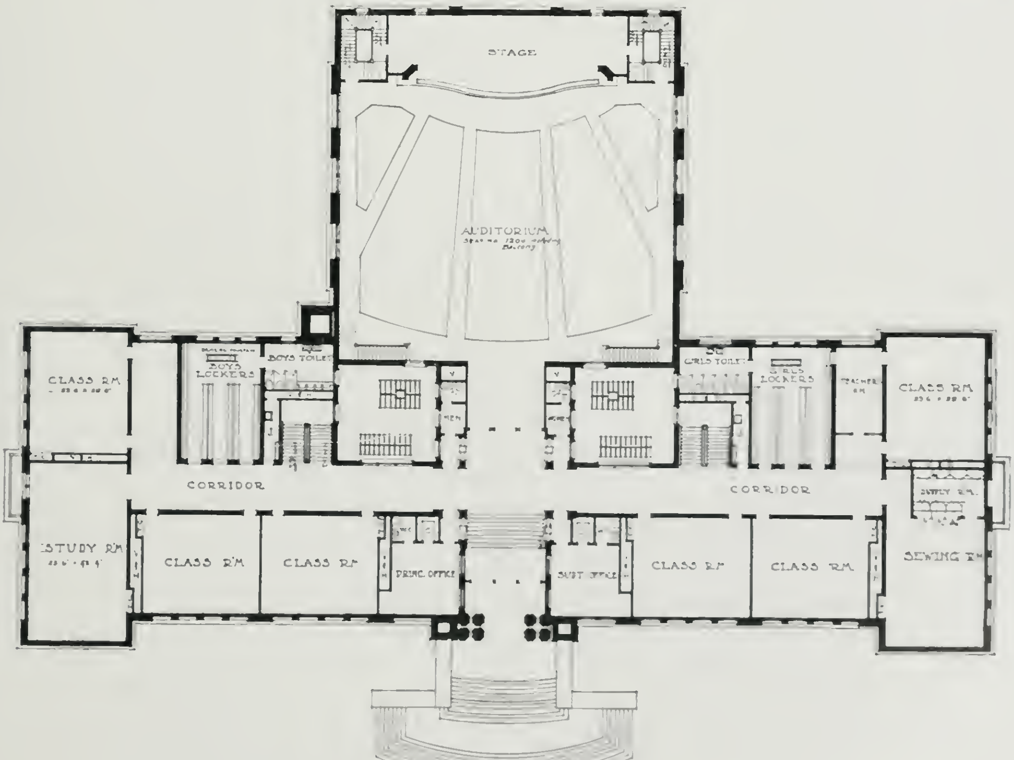
PLAINFIELD HIGH SCHOOL, PLAINFIELD, N. J.

ABOVE, AUDITORIUM; BELOW, GYMNASIUM, PLAINFIELD HIGH SCHOOL.

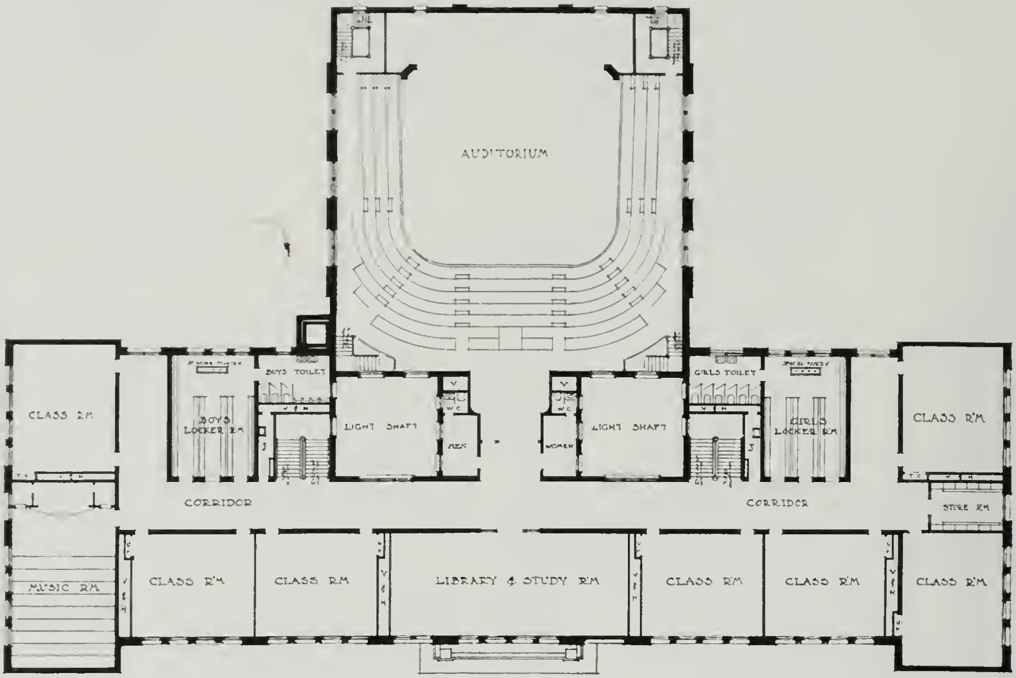
NORWOOD HIGH SCHOOL, NORWOOD, O.
Bausmith & Drainie, Architects, Cincinnati O.



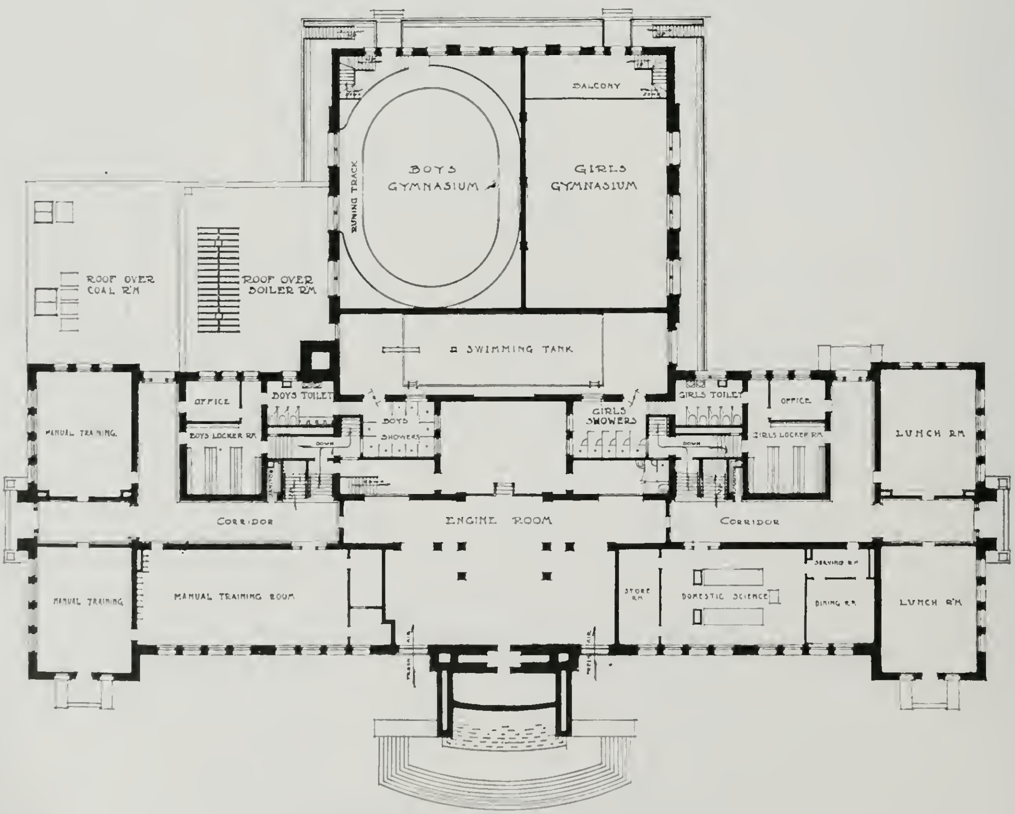
THIRD FLOOR PLAN, NORWOOD HIGH SCHOOL.



FIRST FLOOR PLAN, NORWOOD HIGH SCHOOL.



SECOND FLOOR PLAN, NORWOOD HIGH SCHOOL.

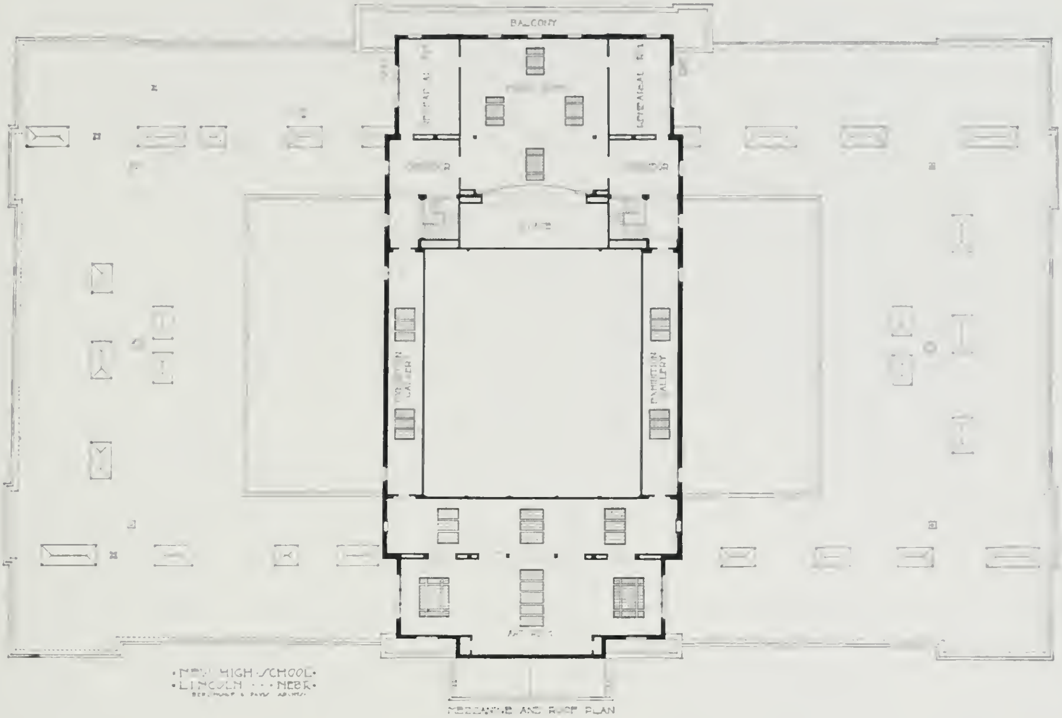


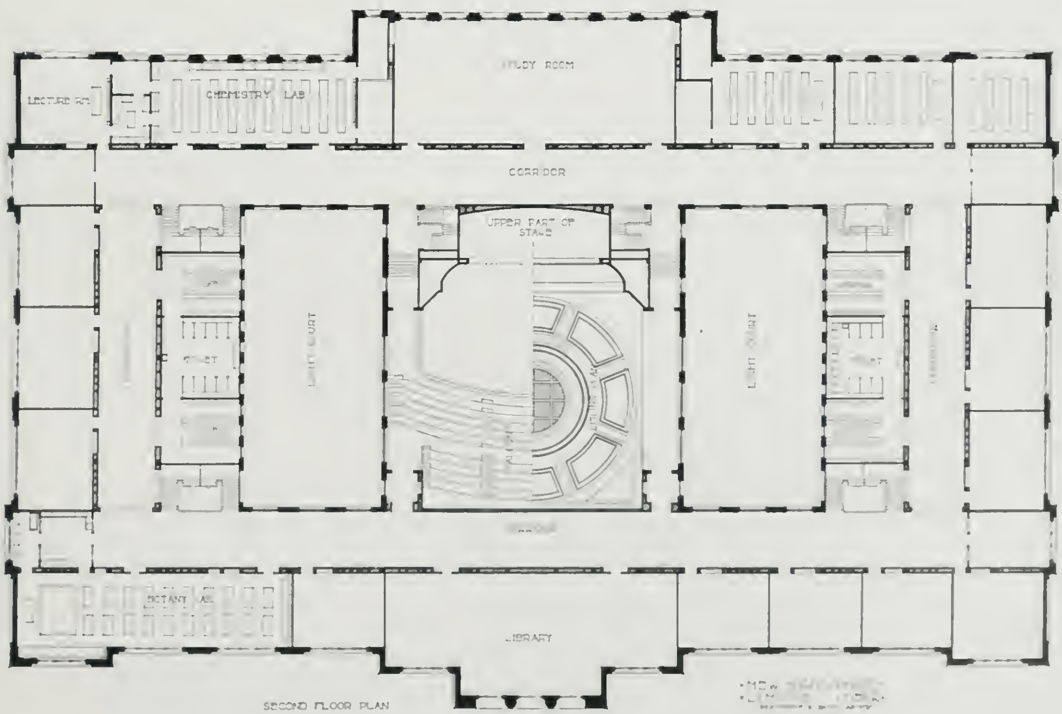
BASEMENT PLAN, NORWOOD HIGH SCHOOL.
Bausmith & Drainie, Architects, Cincinnati O.

DETAIL, NORWOOD HIGH SCHOOL.

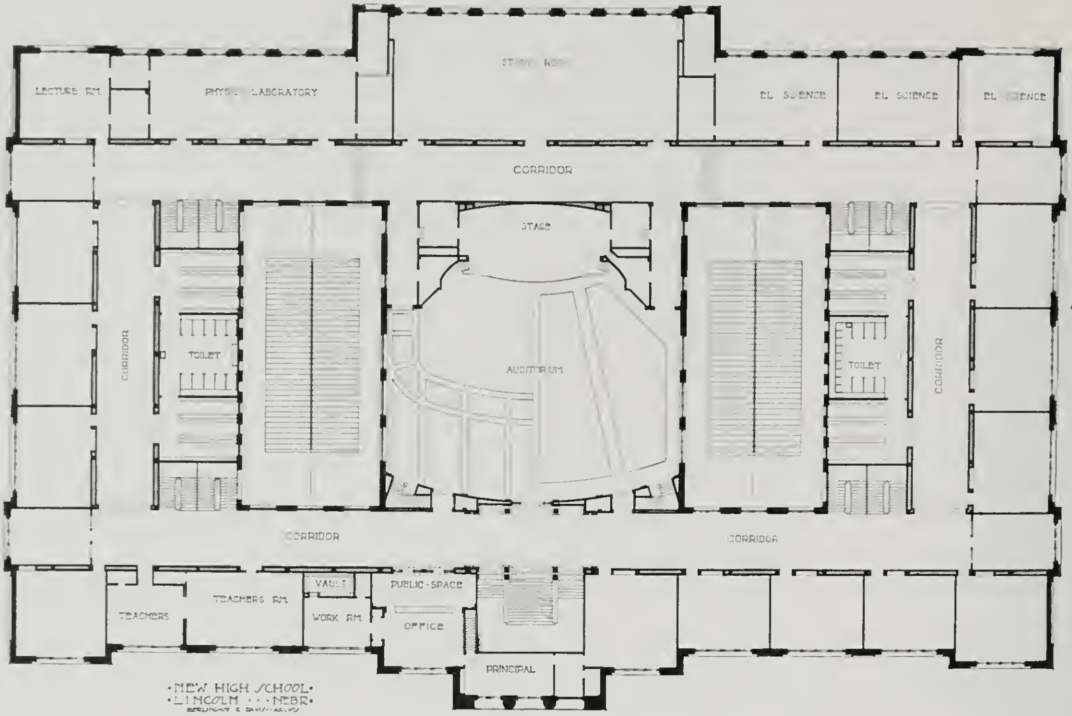
GIRLS' ENTRANCE DETAIL, NORWOOD HIGH SCHOOL.

LINCOLN HIGH SCHOOL, LINCOLN, NEB.
Berlinghof & Davis, Architects, Lincoln.

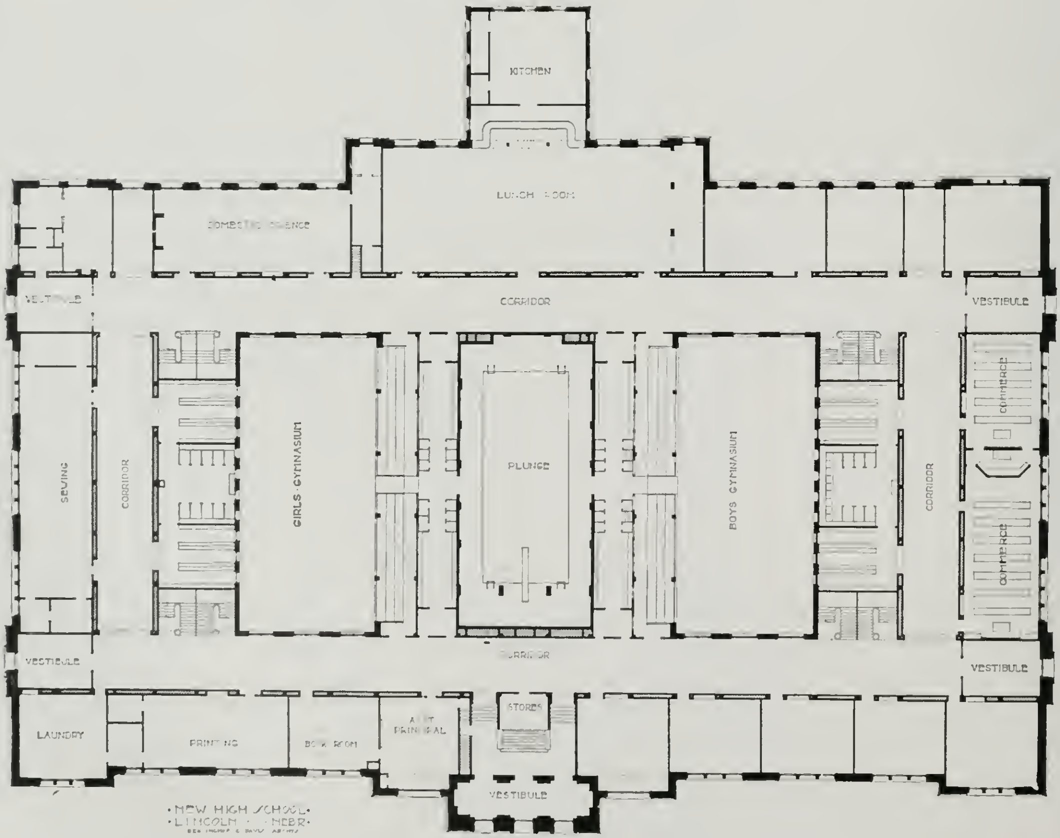




FLOOR PLANS, LINCOLN HIGH SCHOOL, LINCOLN, NEB.
Berlinghof & Davis, Architects, Lincoln.

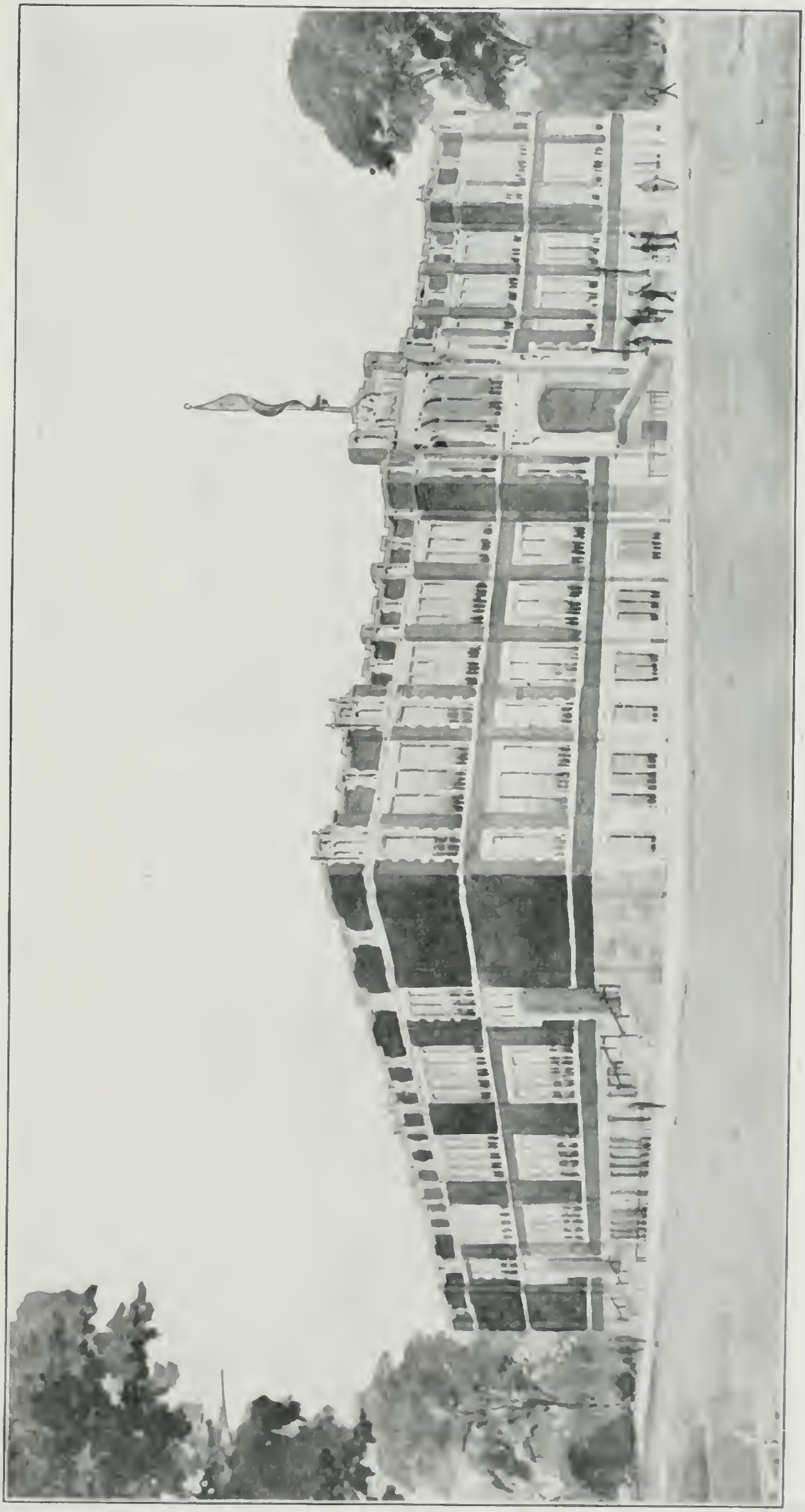


FIRST FLOOR·PLAN

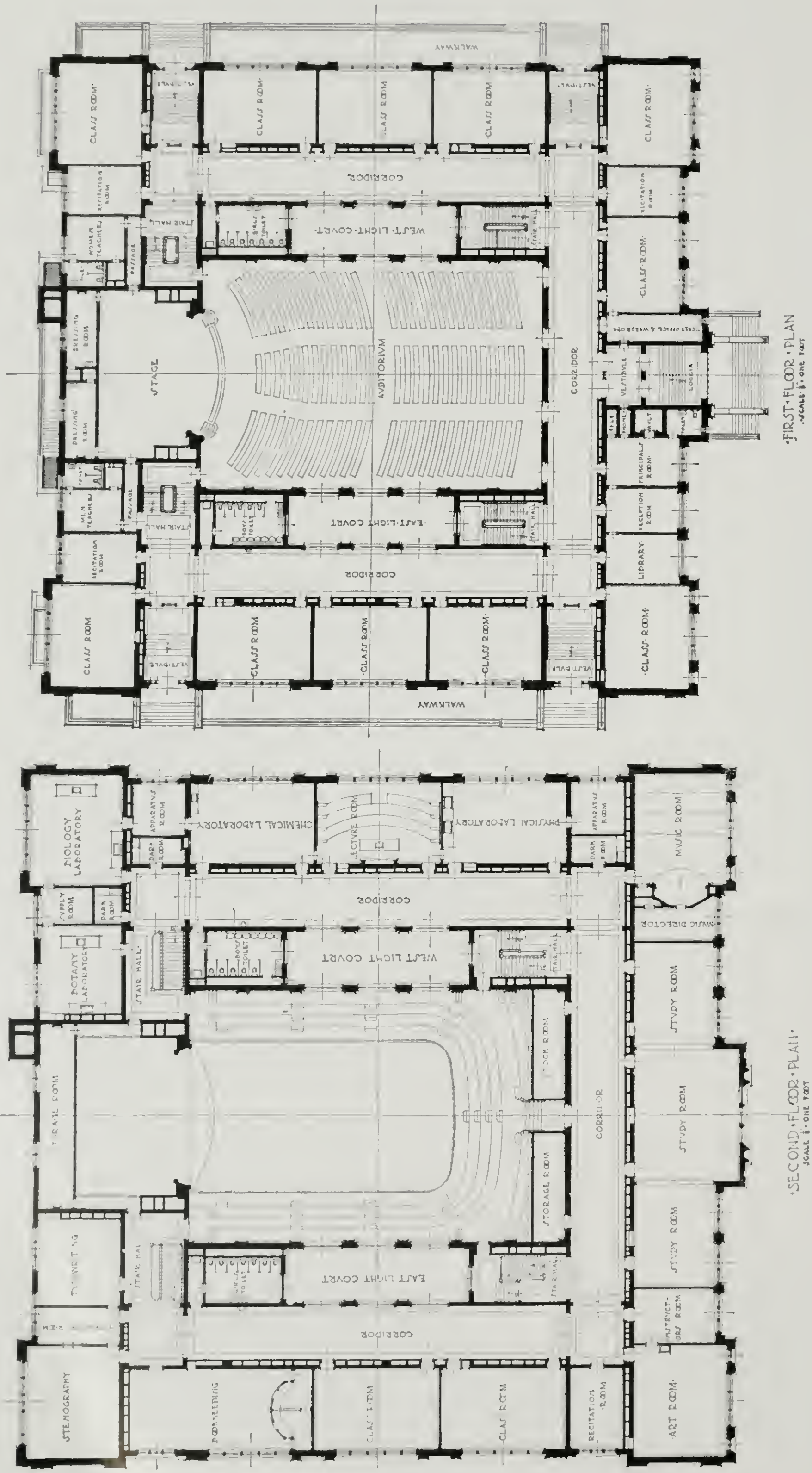


GROUND FLOOR PLAN

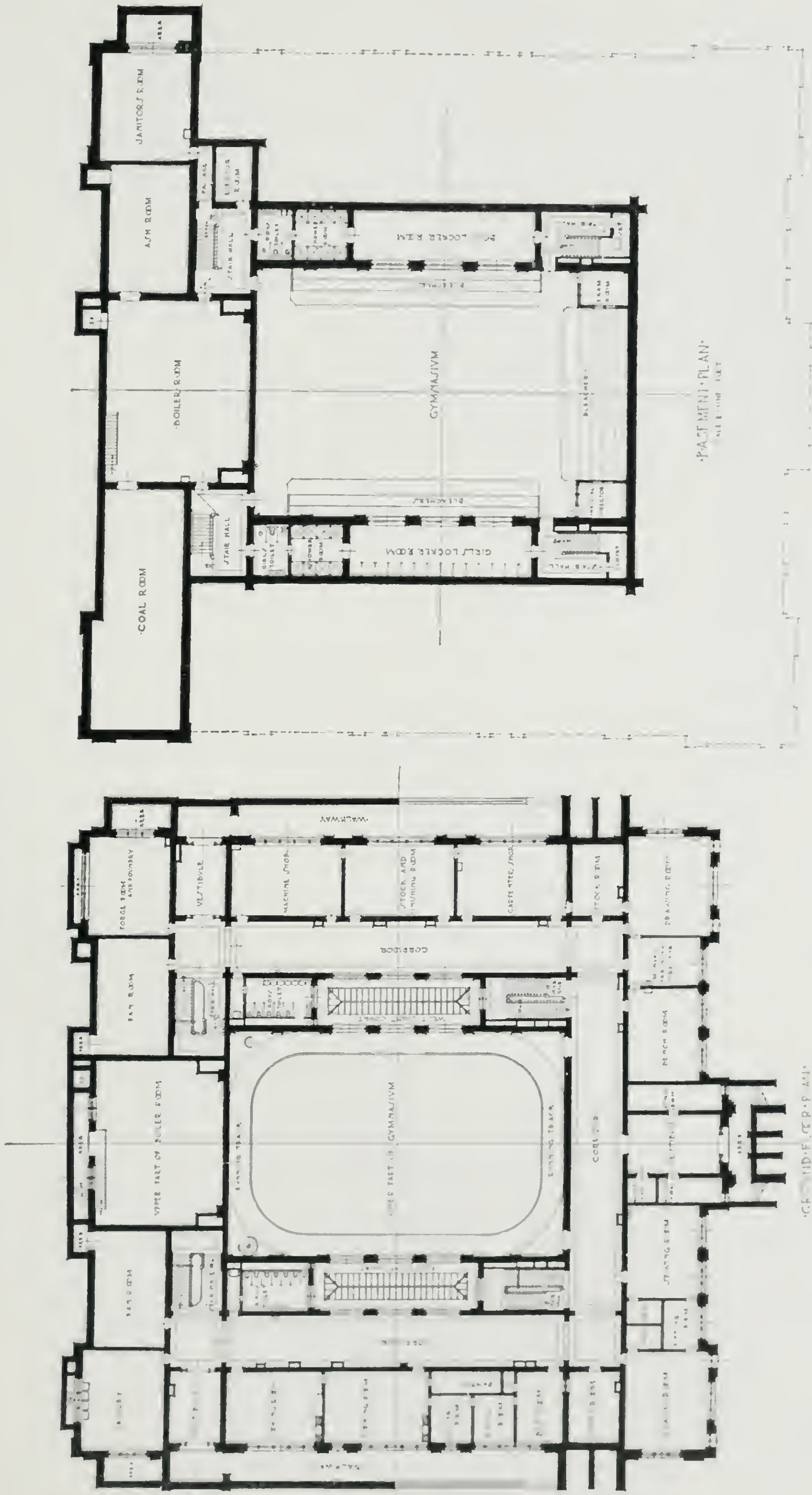
FLOOR PLANS, LINCOLN HIGH SCHOOL, LINCOLN, NEB.



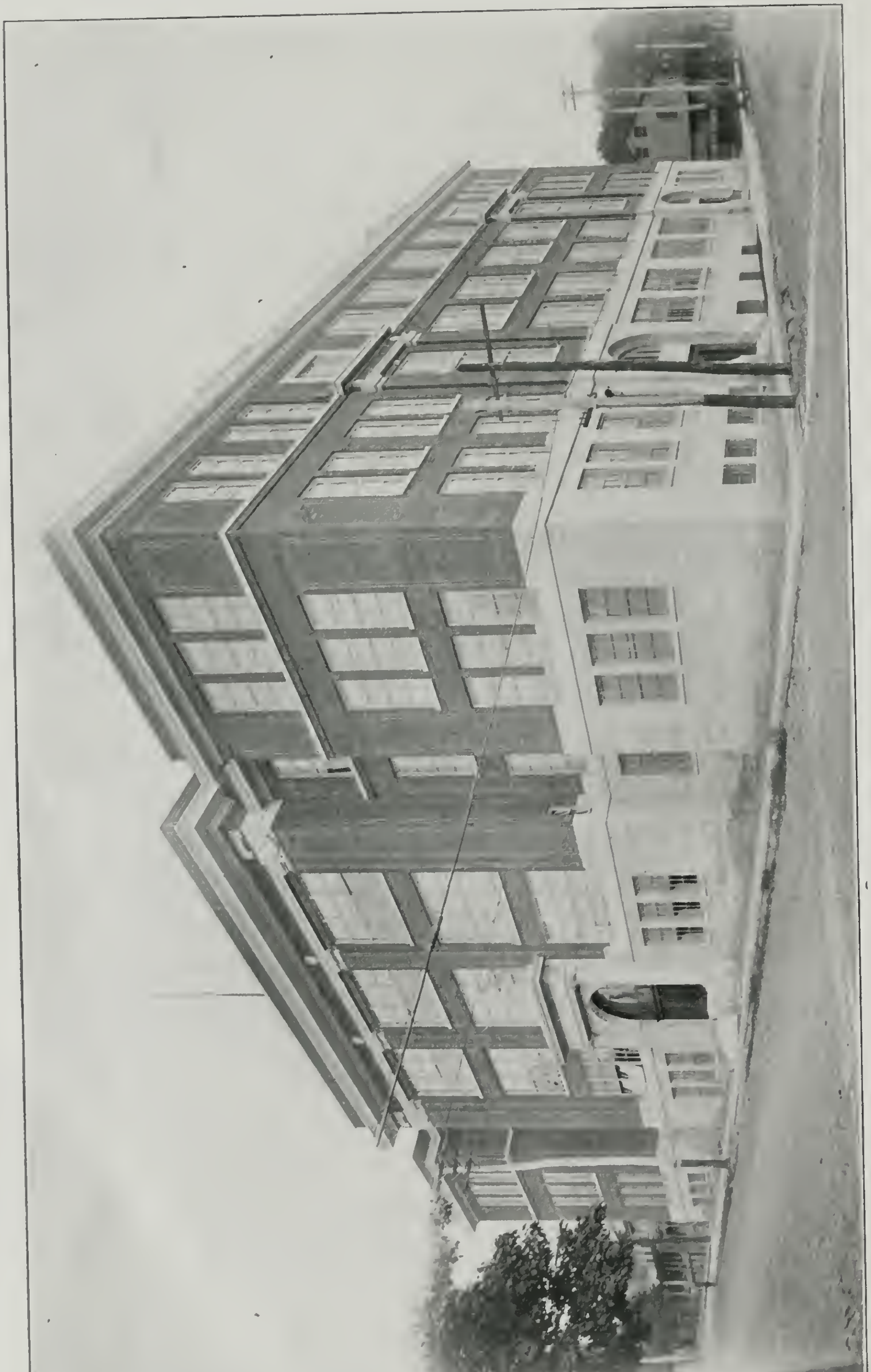
NEW HIGH SCHOOL, LEBANON, PA.
A. A. Richter, Architect, Reading, Pa.



FLOOR PLANS, NEW HIGH SCHOOL, LEBANON, PA.
A. A. Richter, Architect, Reading, Pa.

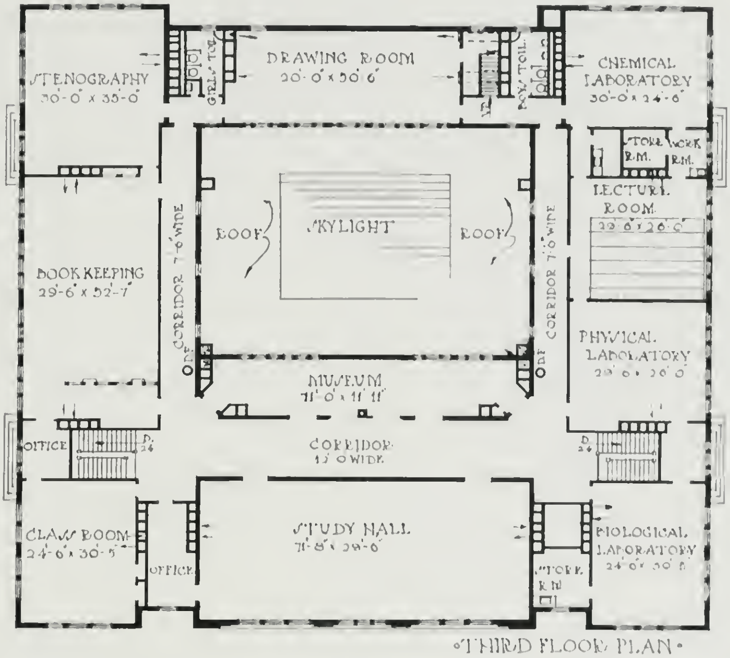


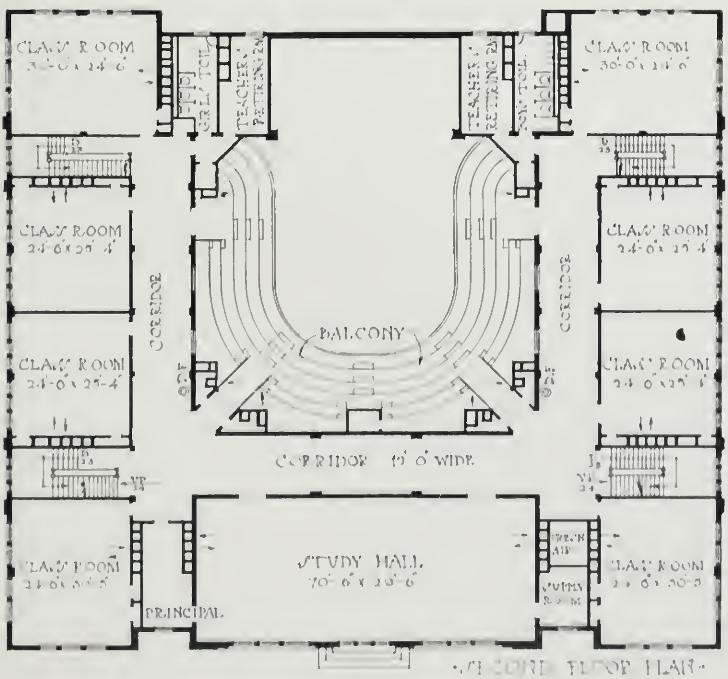
FLOOR PLANS, NEW HIGH SCHOOL, LEBANON, PA.
A. A. Richter, Architect, Reading, Pa.



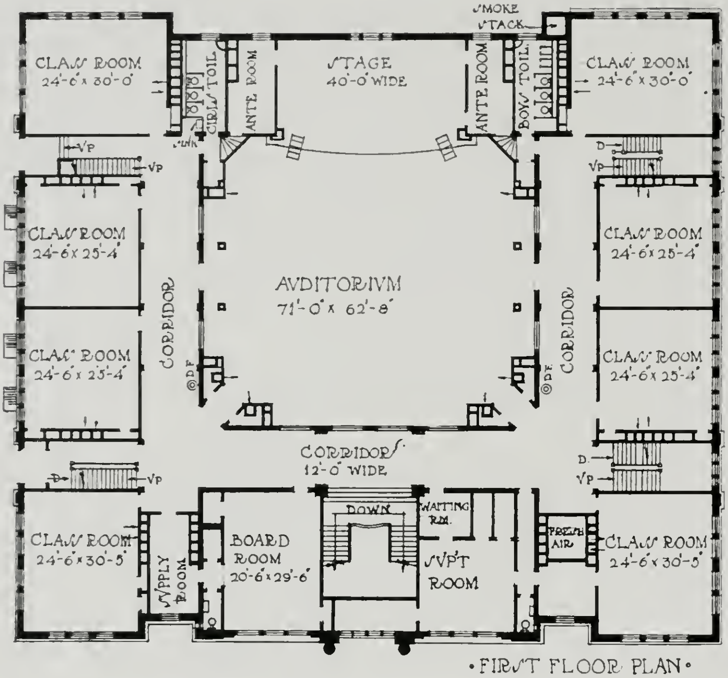
SHAMOKIN HIGH SCHOOL, SHAMOKIN, PA.
W. H. Lee, Architect, Shamokin.

PLAN OF THIRD FLOOR.
SHAMOKIN HIGH SCHOOL.

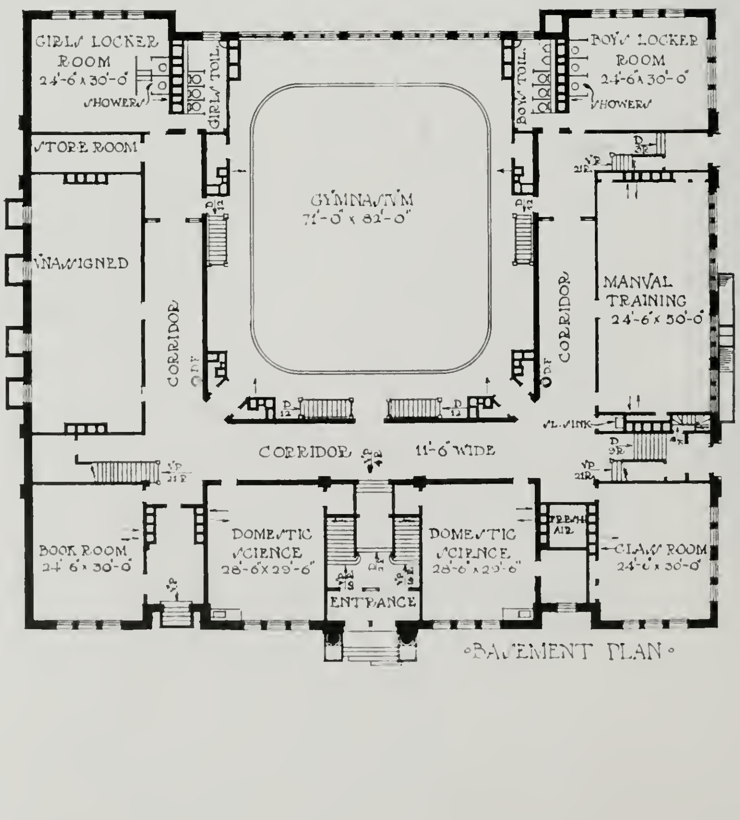




PLAN OF SECOND FLOOR.
SHAMOKIN HIGH SCHOOL.



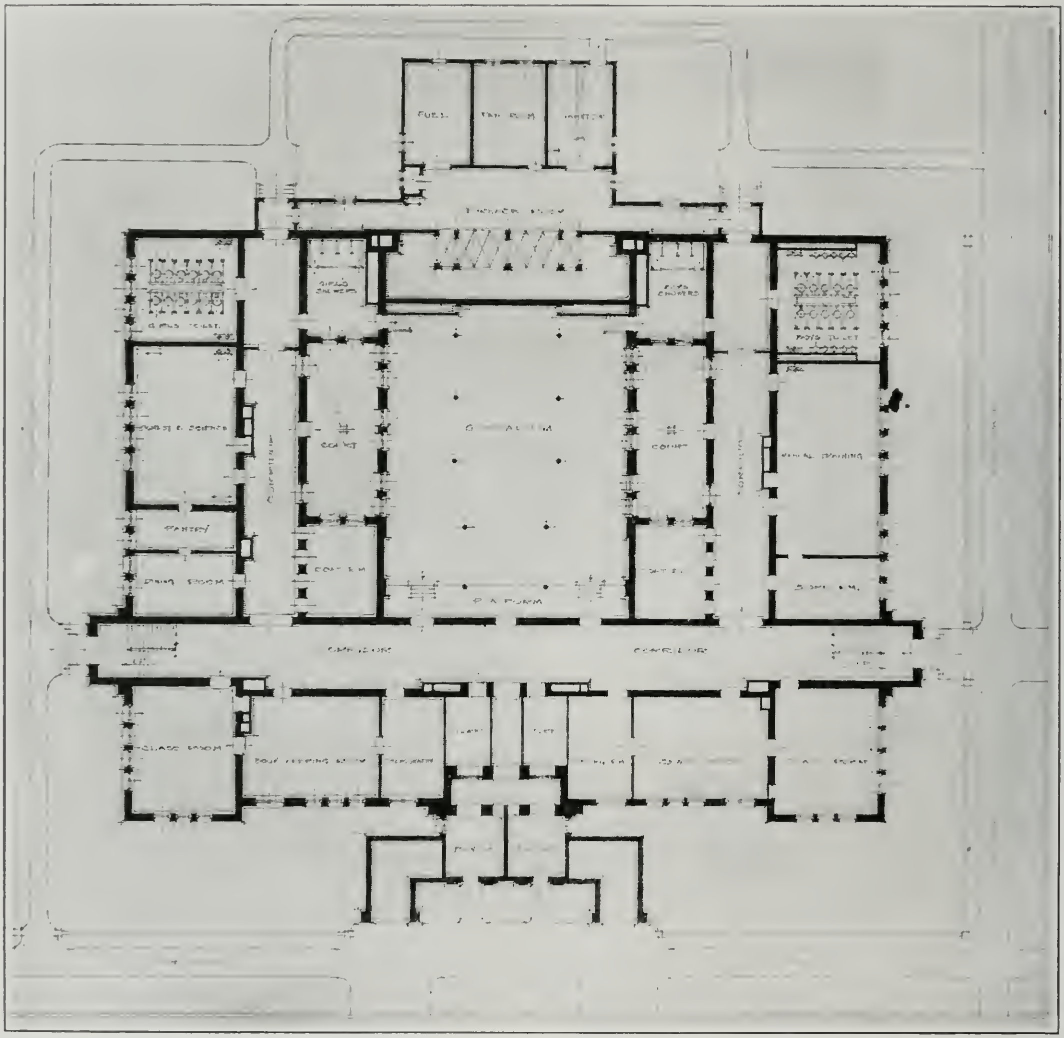
PLAN OF FIRST FLOOR.
SHAMOKIN HIGH SCHOOL.



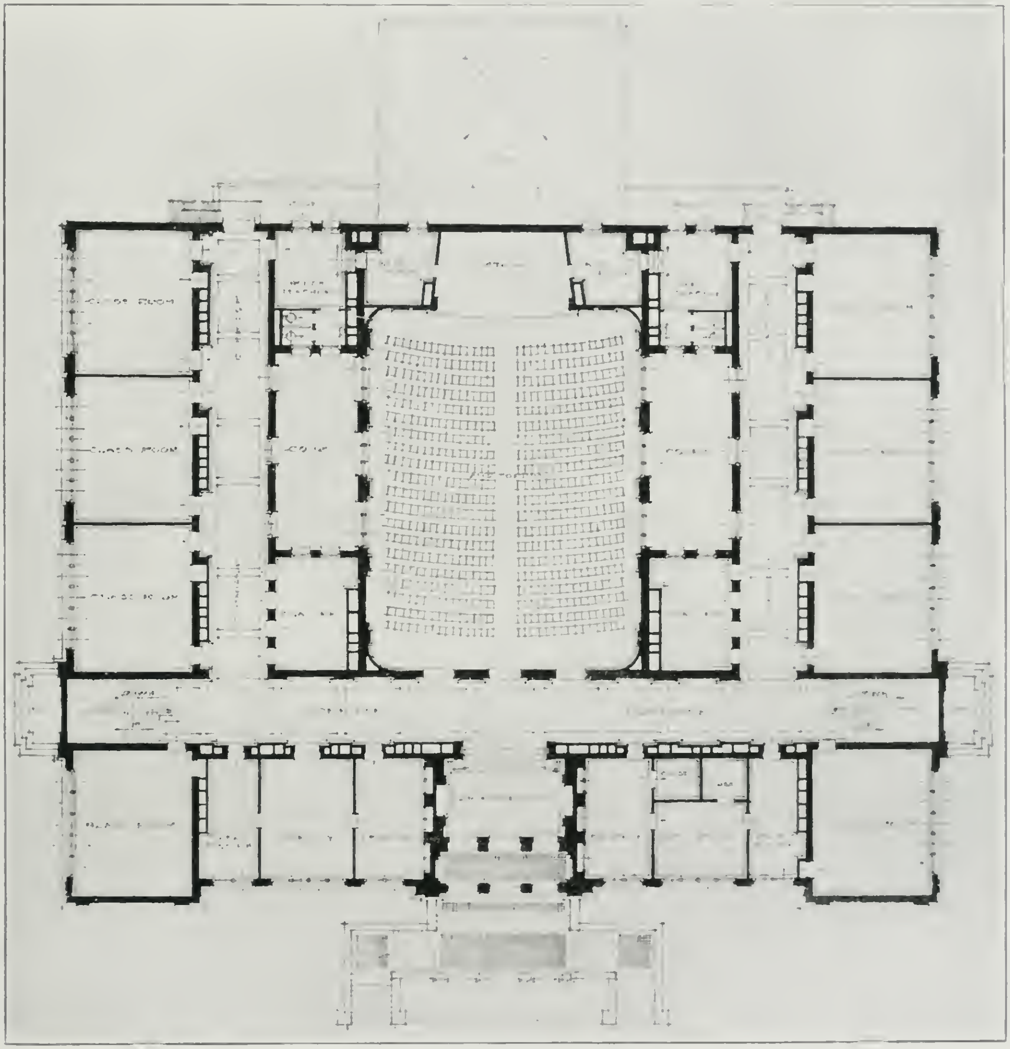
PLAN OF BASEMENT.
SHAMOKIN HIGH SCHOOL.

W. H. Lee, Architect,
Shamokin, Pa.

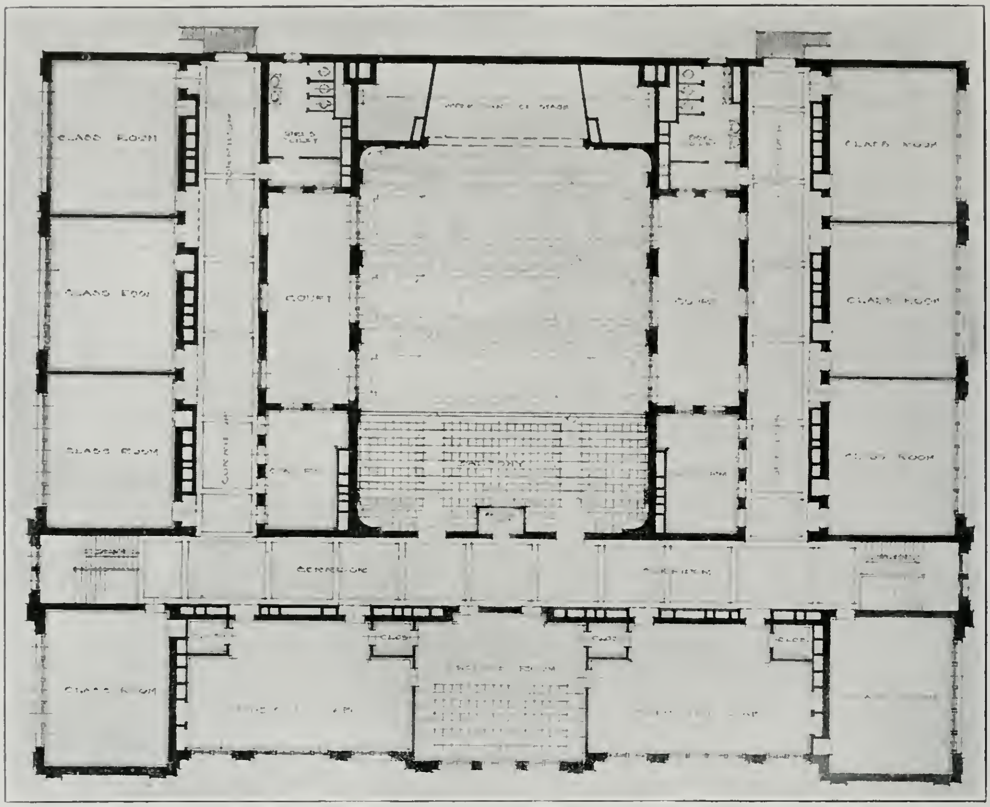
NEW HIGH SCHOOL, COLUMBIA, S. C.
Urquhart & Johnson, Architects, Columbia, S. C.



GROUND FLOOR PLAN, NEW HIGH SCHOOL, COLUMBIA, S. C.
Urquhart & Johnson, Architects, Columbia, S. C.

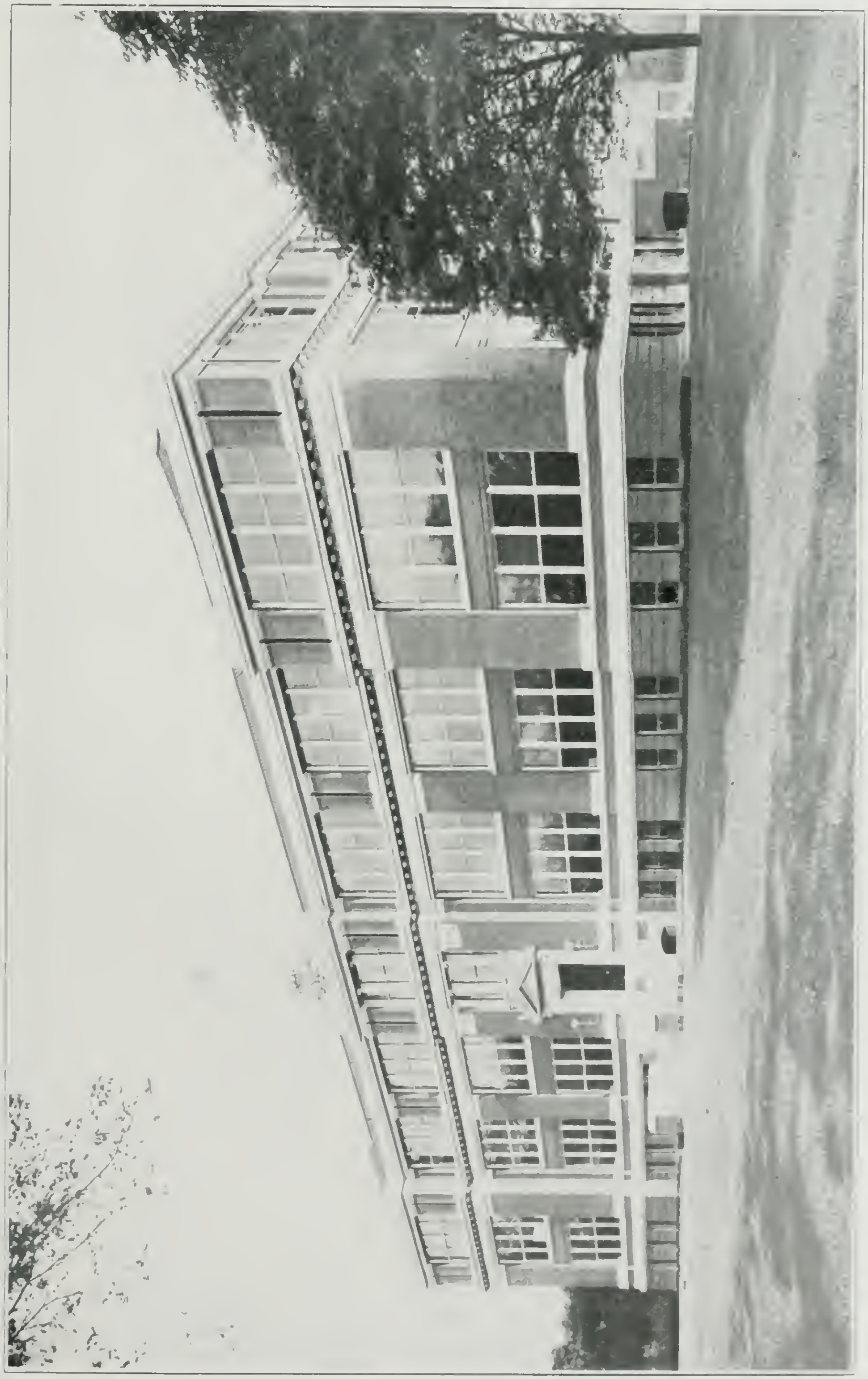


FIRST FLOOR PLAN, NEW HIGH SCHOOL, COLUMBIA, S. C.
Urquhart & Johnson, Architects, Columbia, S. C.

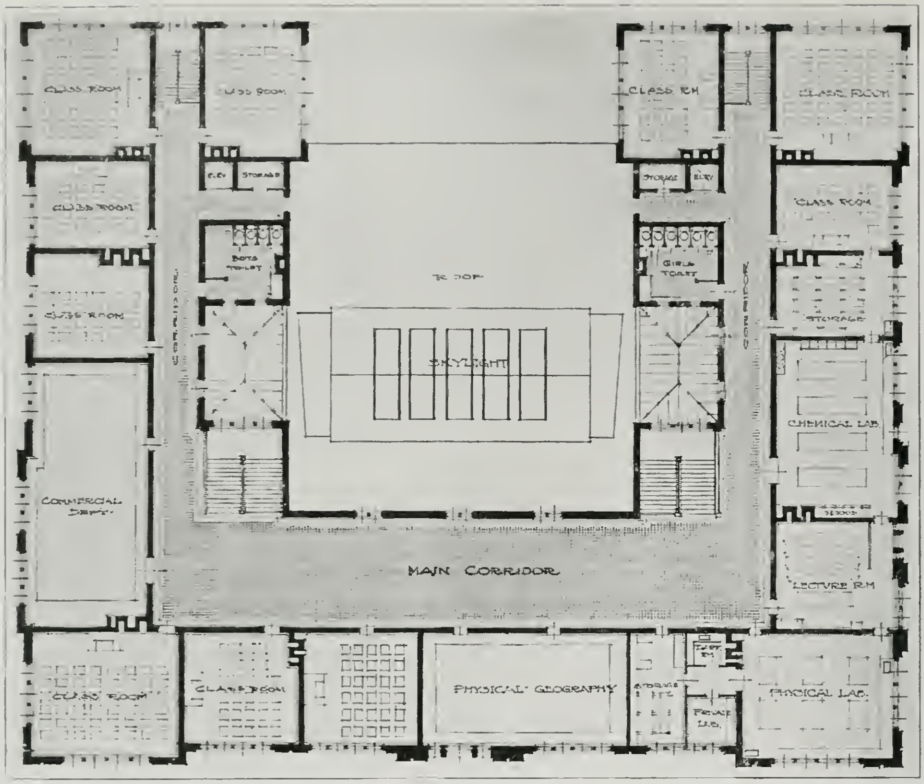


SECOND FLOOR PLAN, NEW HIGH SCHOOL, COLUMBIA, S. C.

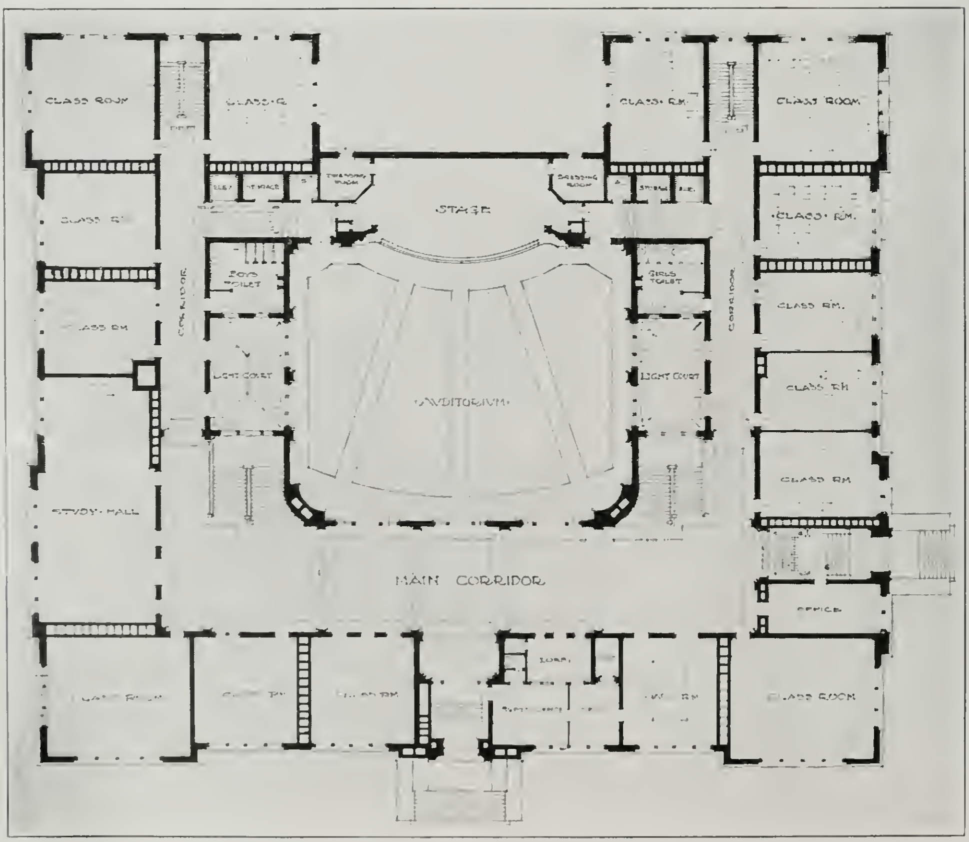
MAIN CORRIDOR, HIGH SCHOOL, NEW CASTLE, PA.



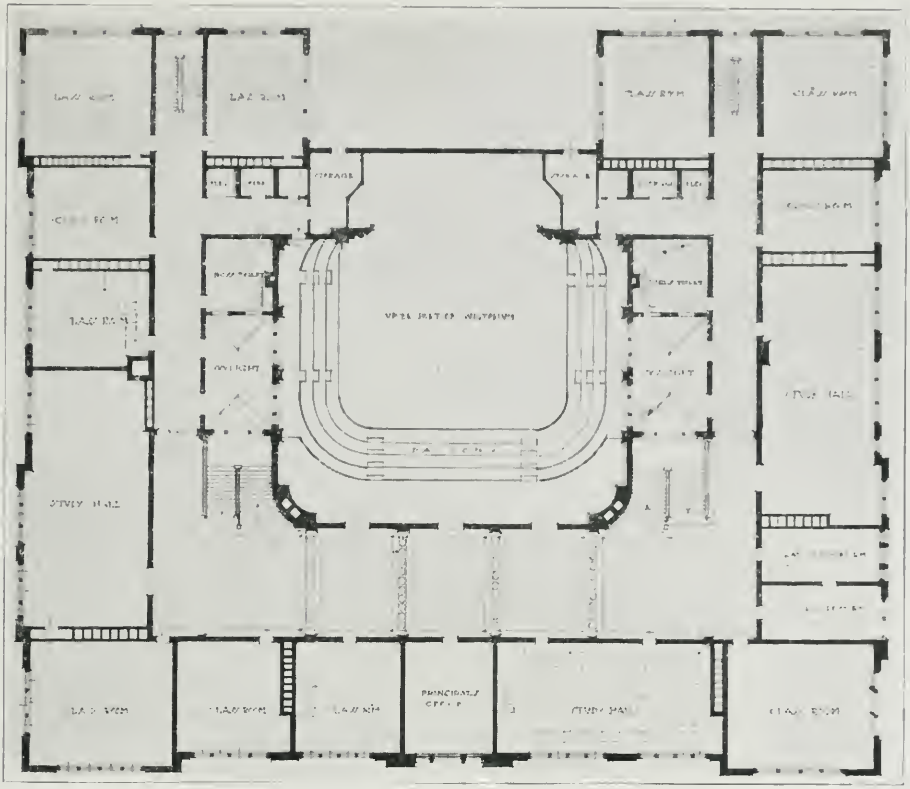
HIGH SCHOOL, NEW CASTLE, PA.
W. G. Eckles, Architect, New Castle,



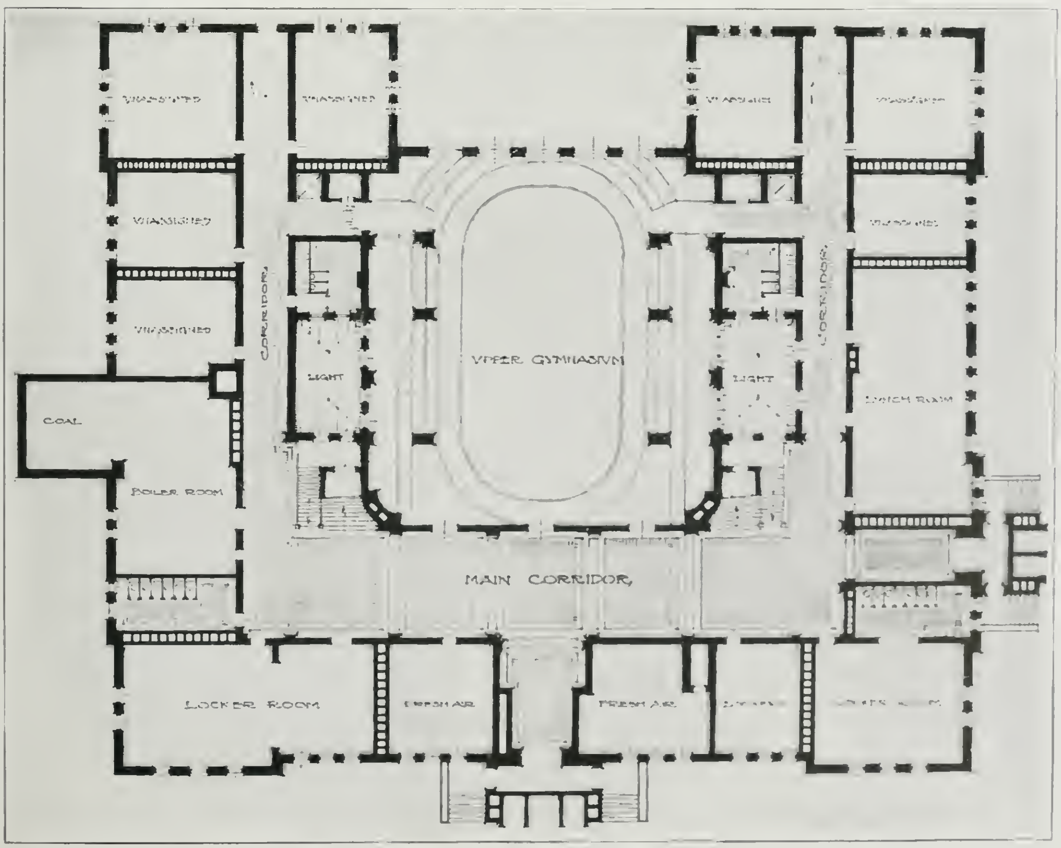
THIRD FLOOR PLAN, HIGH SCHOOL, NEW CASTLE, PA.



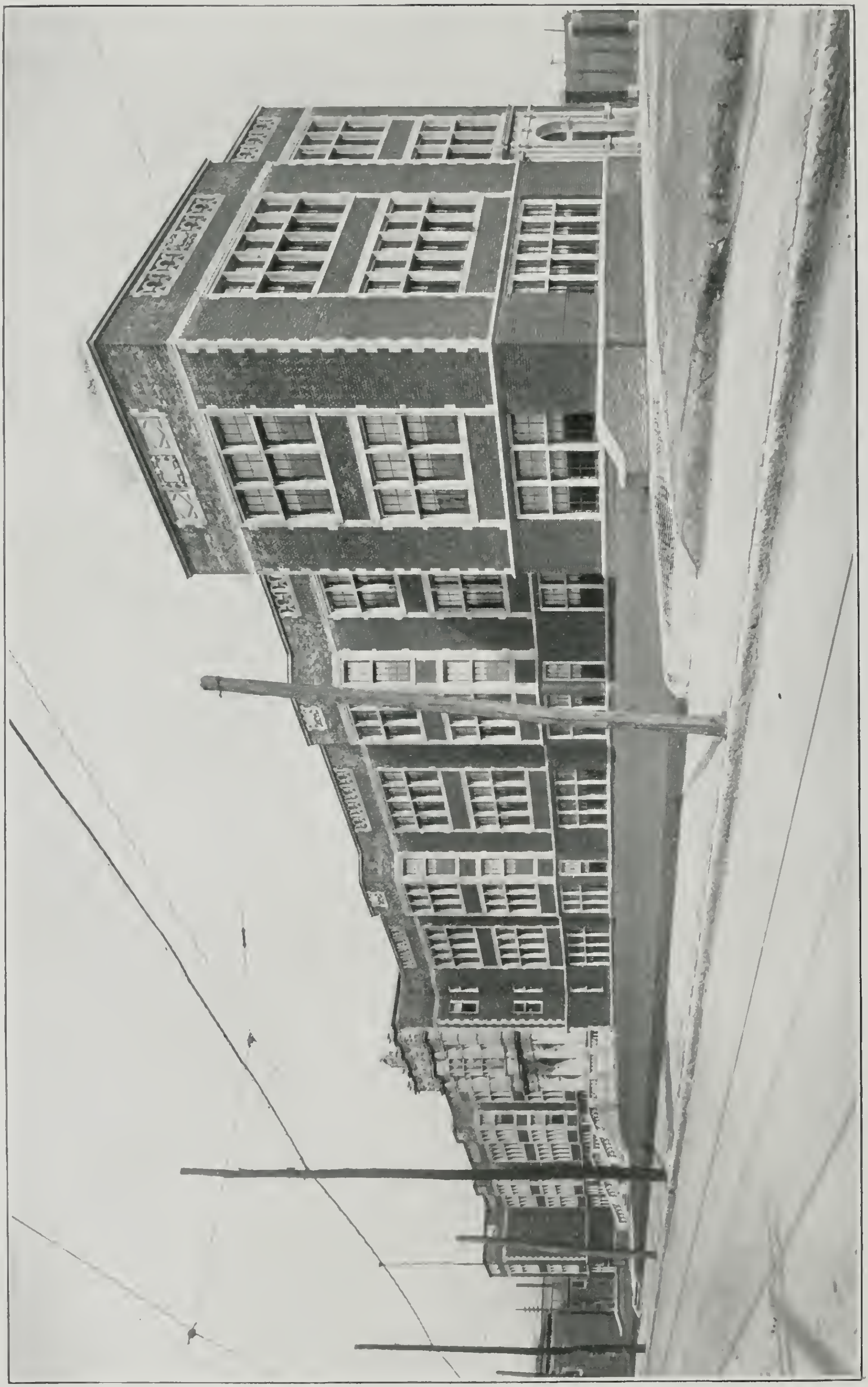
FIRST FLOOR PLAN, HIGH SCHOOL, NEW CASTLE, PA.



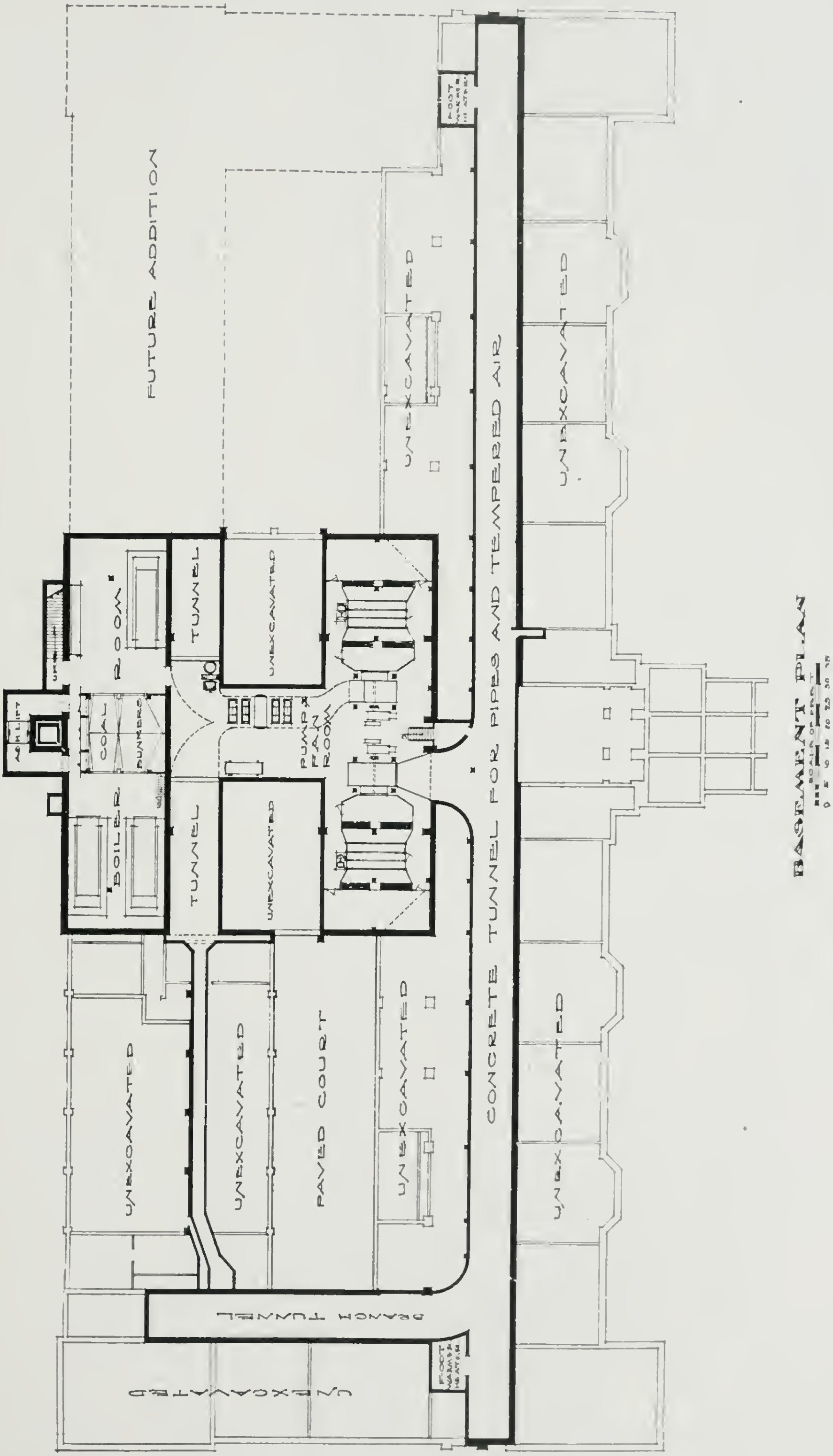
SECOND FLOOR PLAN, HIGH SCHOOL, NEW CASTLE, PA.



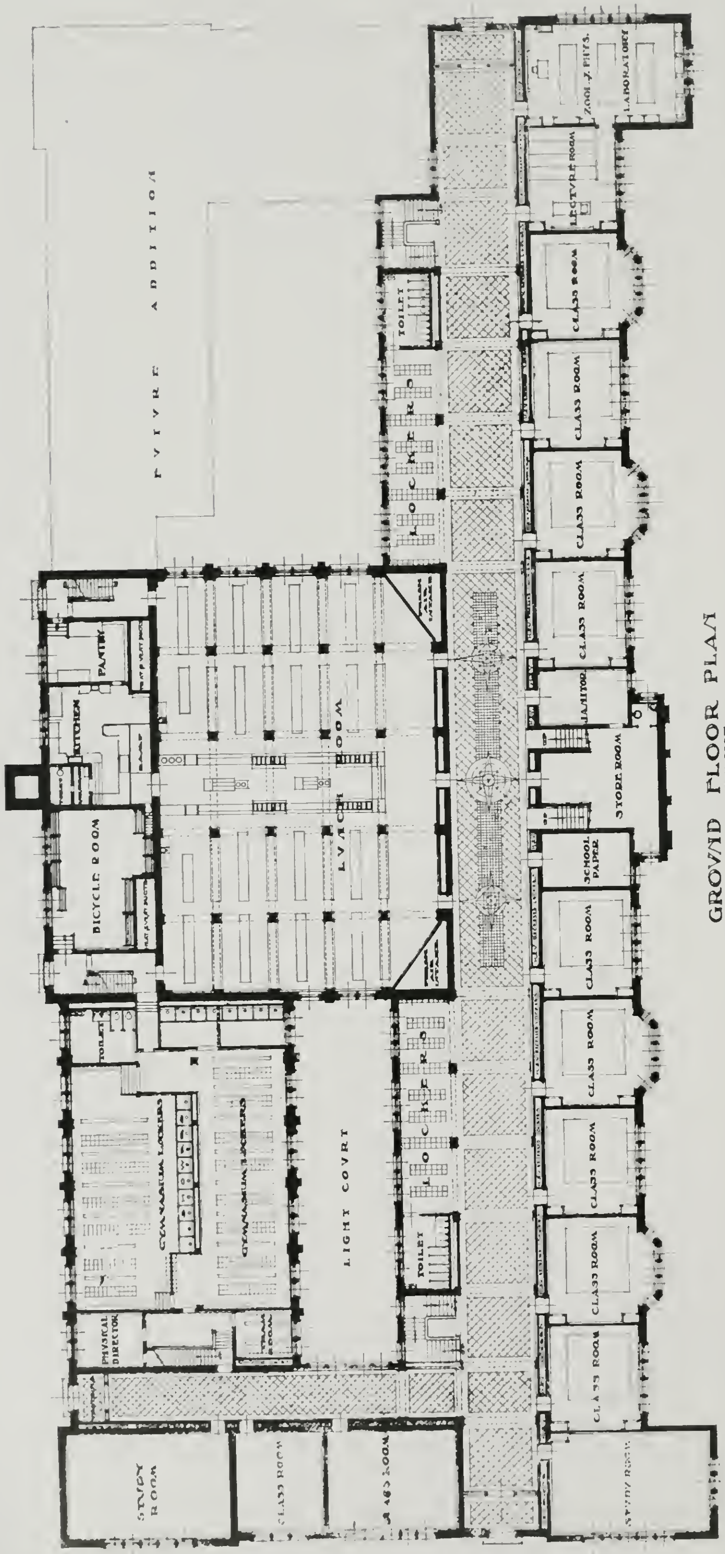
BASEMENT PLAN, HIGH SCHOOL, NEW CASTLE, PA.



BOYS' HIGH SCHOOL, LOUISVILLE, KY.
J. Earl Henry, Architect of the Board of Education, Louisville.

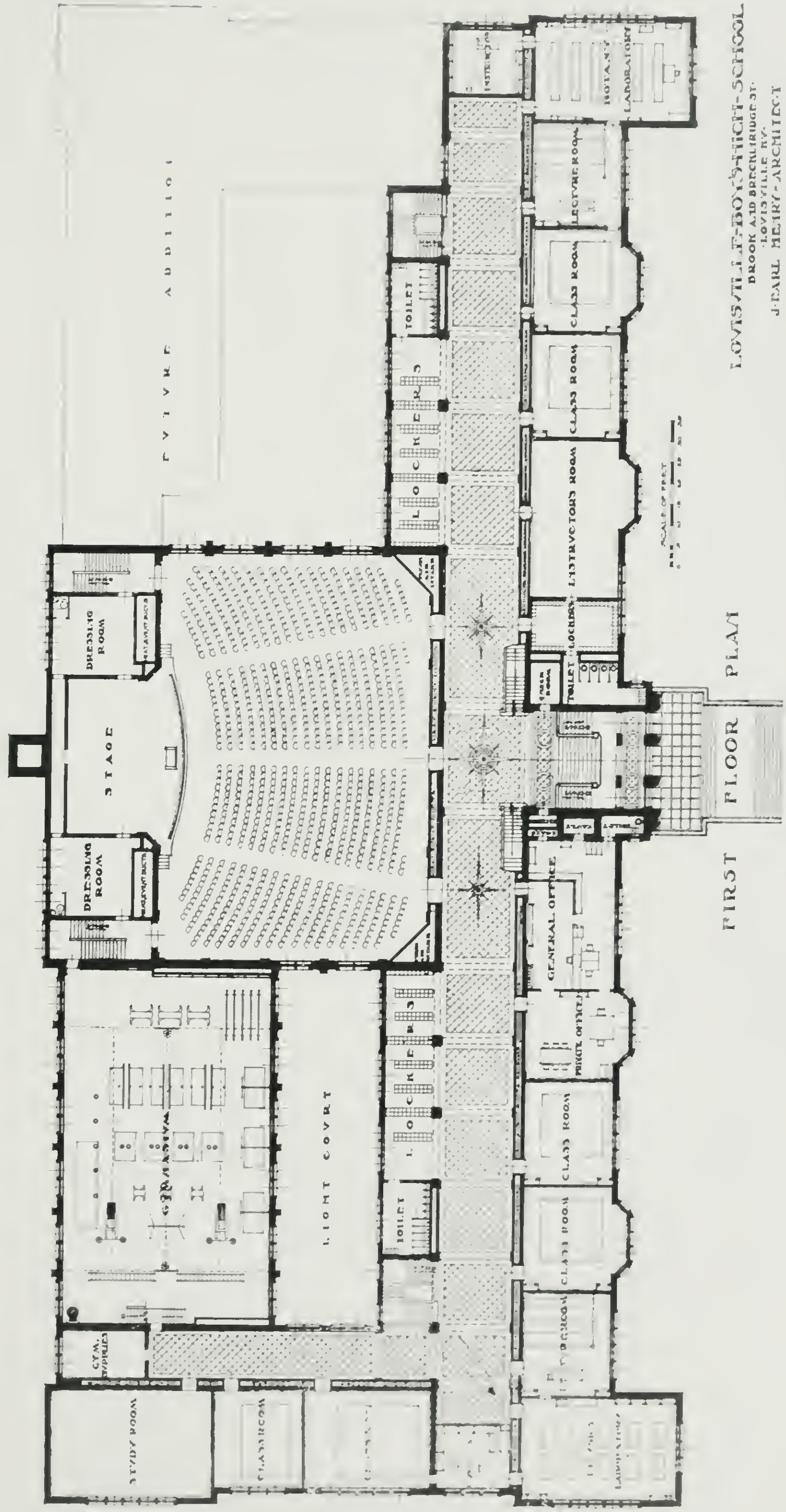


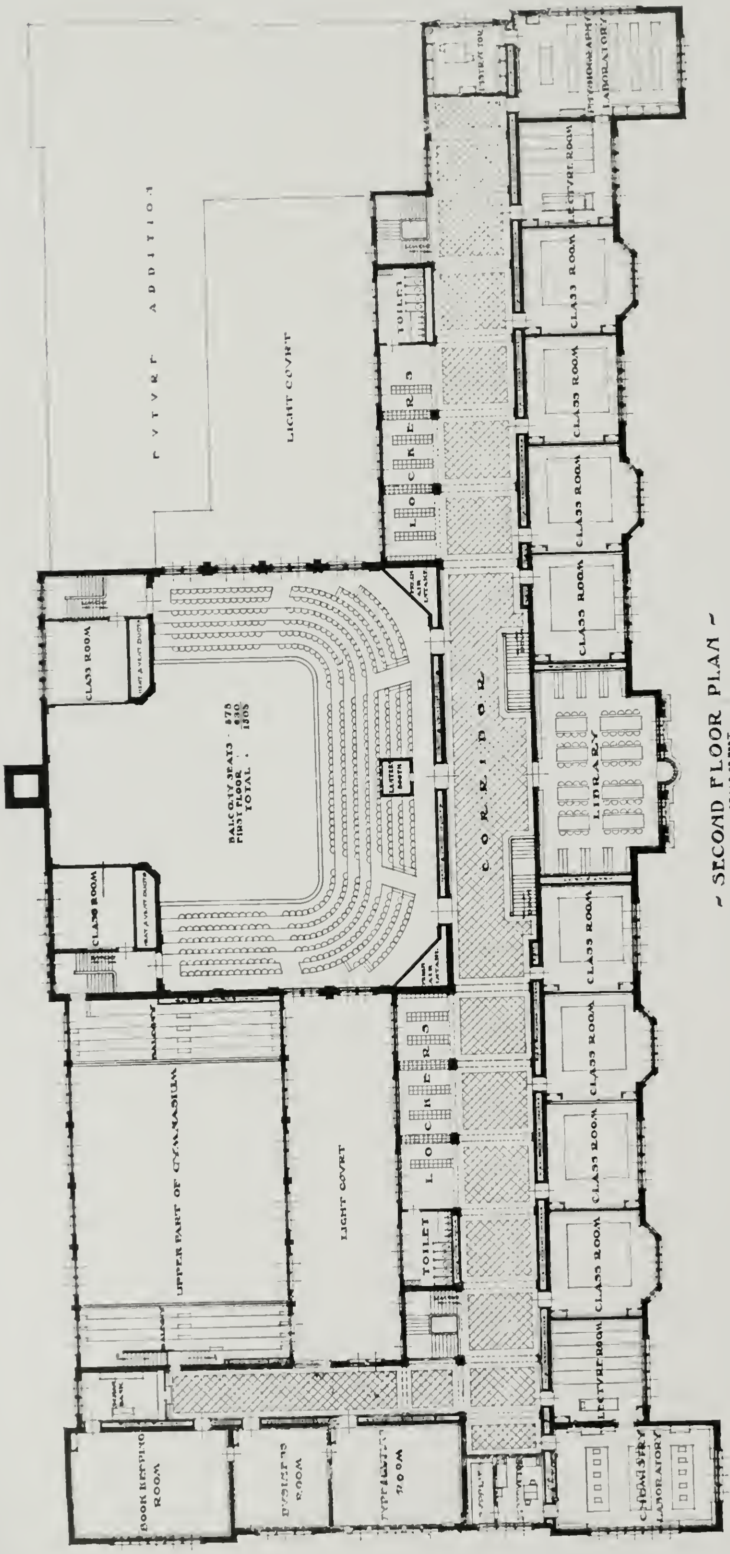
BASEMENT PLAN, BOYS' HIGH SCHOOL, LOUISVILLE, KY.



GROUND FLOOR PLAN

BOYS' HIGH SCHOOL, LOUISVILLE, KY.


LOUISVILLE BOYS HIGH SCHOOL
FIRST FLOOR PLAN
FUTURE ADDITION
STAGE
DRESSING ROOM
DRESSING ROOM
GYMNASIUM
LIGHT COURT
LOCKERS
LOCKERS
TOILET
TOILET
LECTURE ROOM
CLASS ROOM
CLASS ROOM
INSTRUCTORS ROOM
GENERAL OFFICE
PRIVATE OFFICE
CLASS ROOM
CLASS ROOM
BOTANY LABORATORY
GYM. SUPPLIES
STUDY ROOM



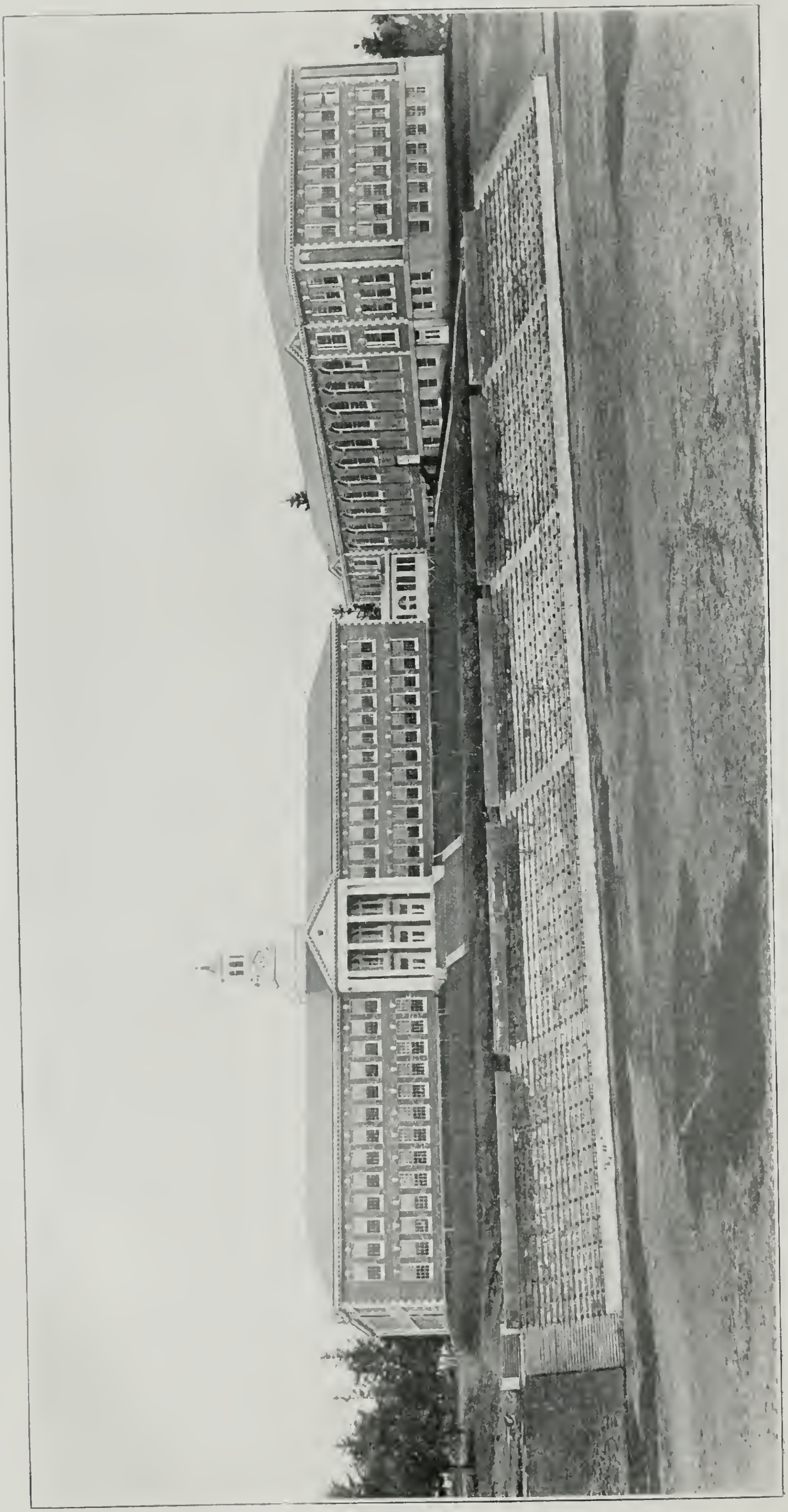
– SECOND FLOOR PLAN –

BOYS' HIGH SCHOOL, LOUISVILLE, KY.

J. Earl Henry, Architect, Board of Education, Louisville.

DETAIL OF MAIN ENTRANCE, BOYS' HIGH SCHOOL, LOUISVILLE, KY.

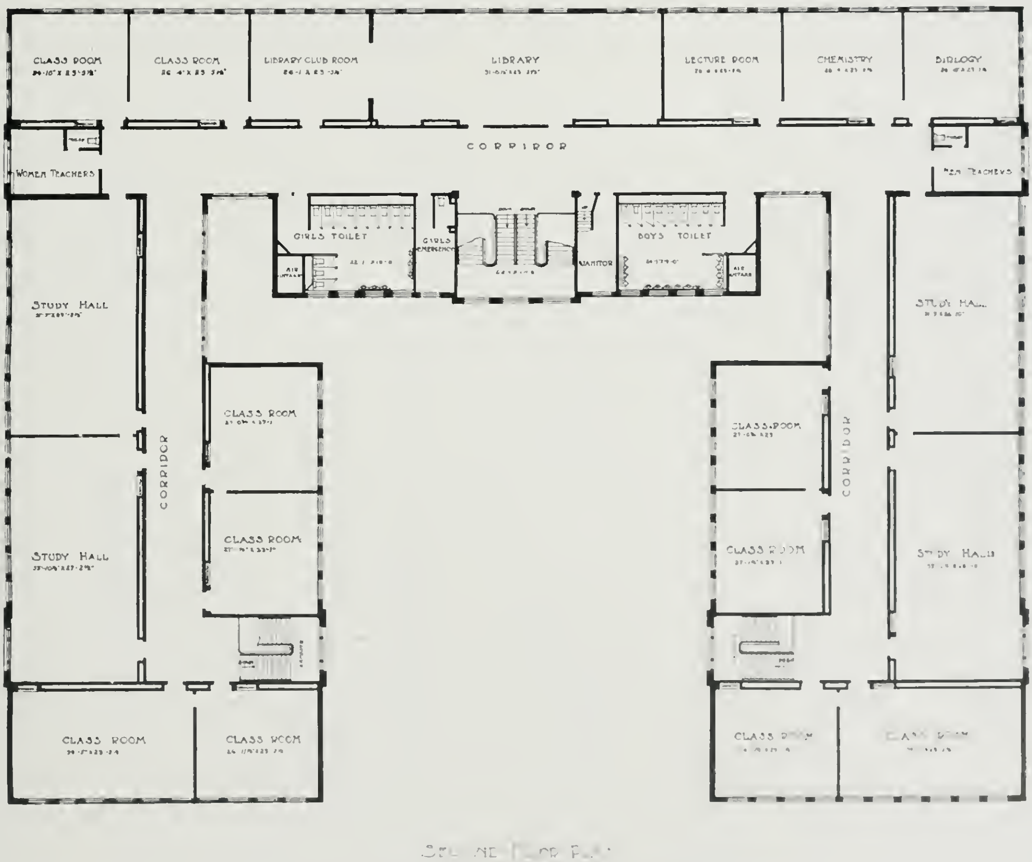
J. Earl Henry, Architect, Board of Education, Louisville.



BENJAMIN FRANKLIN HIGH SCHOOL, PORTLAND, ORE.

F. A. Naramore, Architect of the Board of Education, Portland.

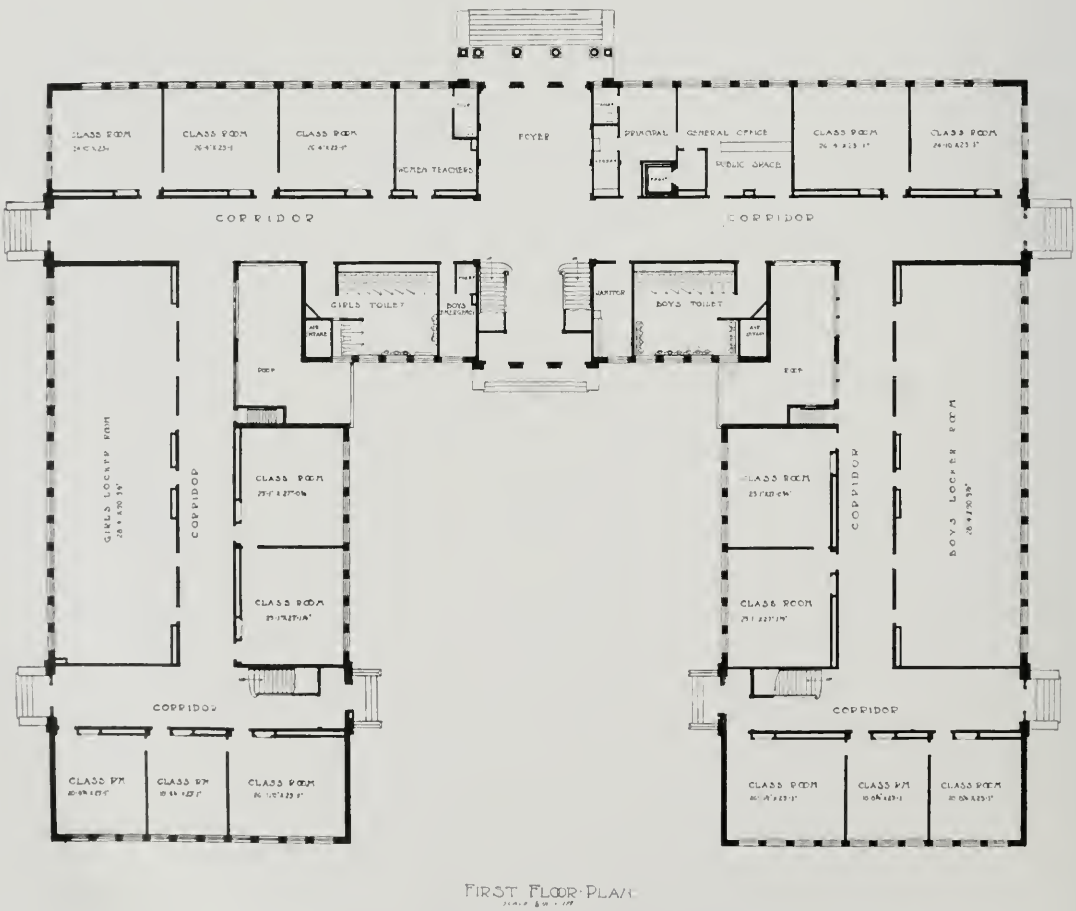
SECOND FLOOR PLAN OF GYMNASIUM AND MANUAL ARTS BUILDING.



SECOND FLOOR PLAN OF MAIN BUILDING.

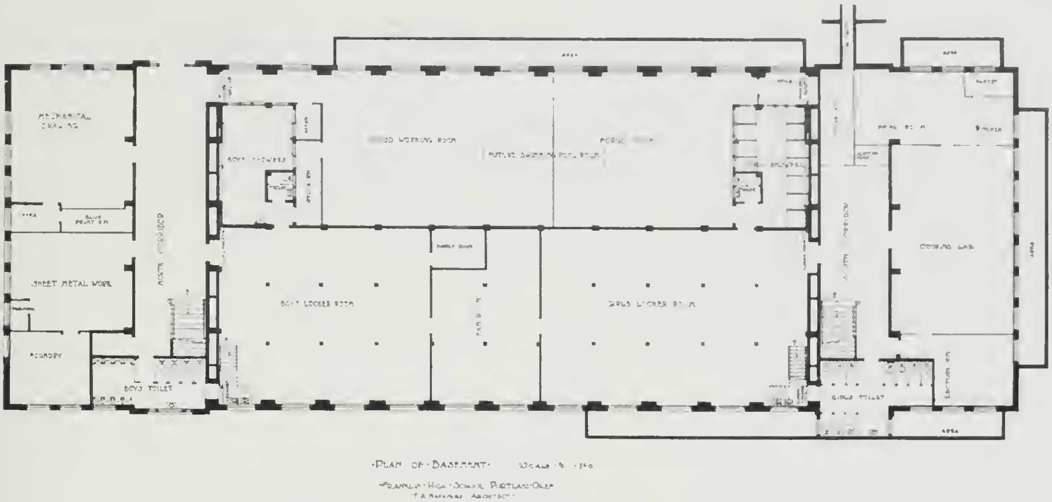
PLANS OF BENJAMIN FRANKLIN HIGH SCHOOL, PORTLAND, ORE.

FIRST FLOOR PLAN, GYMNASIUM AND MANUAL ARTS BUILDING.

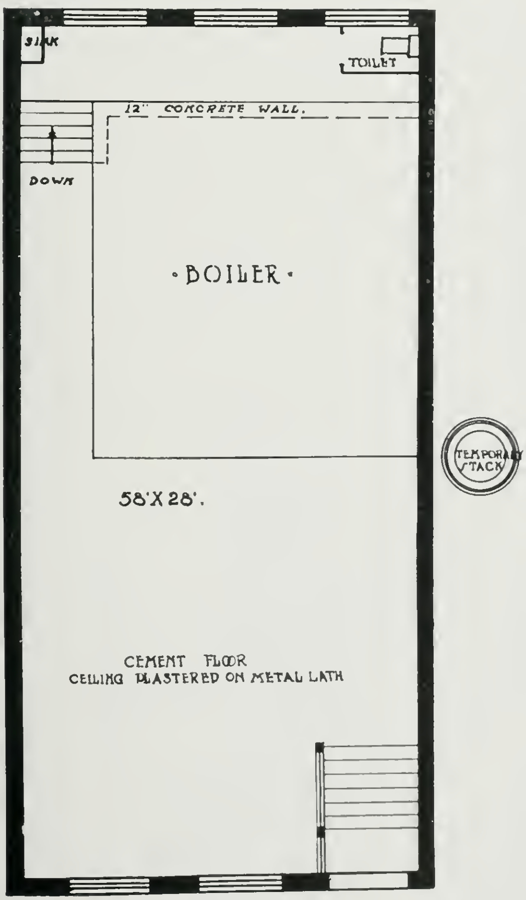


FIRST FLOOR PLAN OF MAIN BUILDING.

FLOOR PLANS OF THE BENJAMIN FRANKLIN HIGH SCHOOL, PORTLAND, ORE.



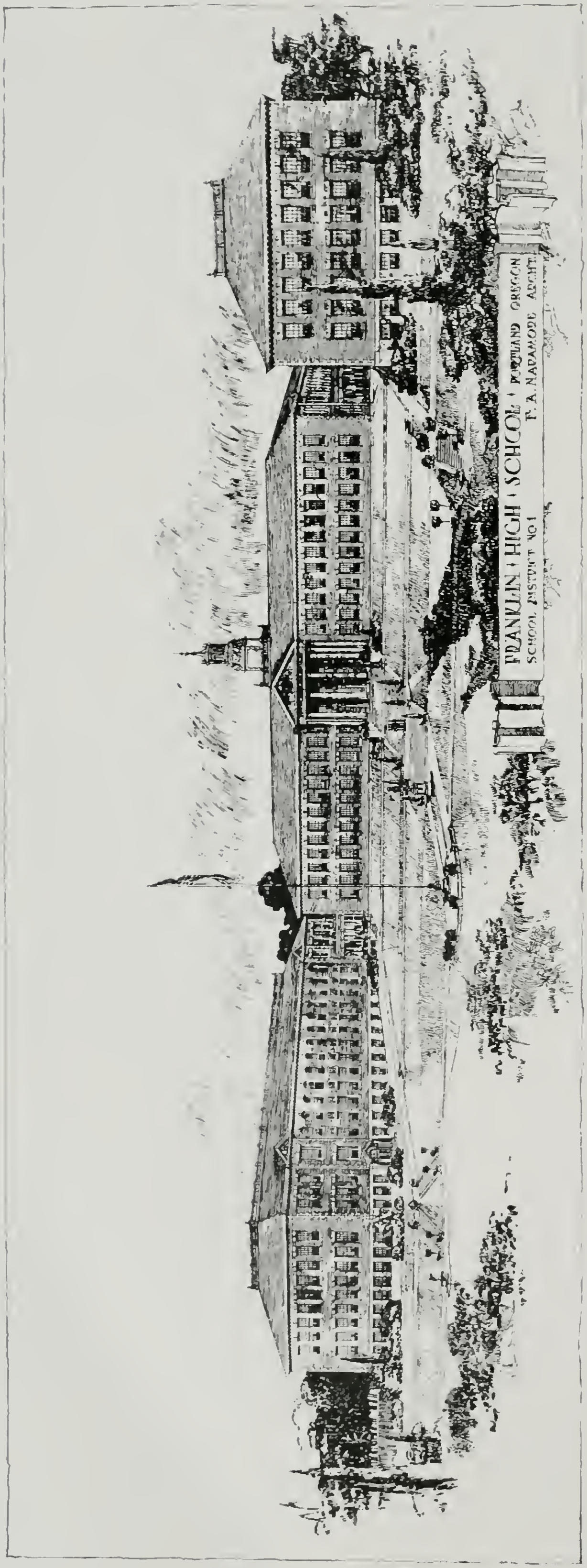
BASEMENT PLAN, GYMNASIUM AND MANUAL ARTS BUILDING.

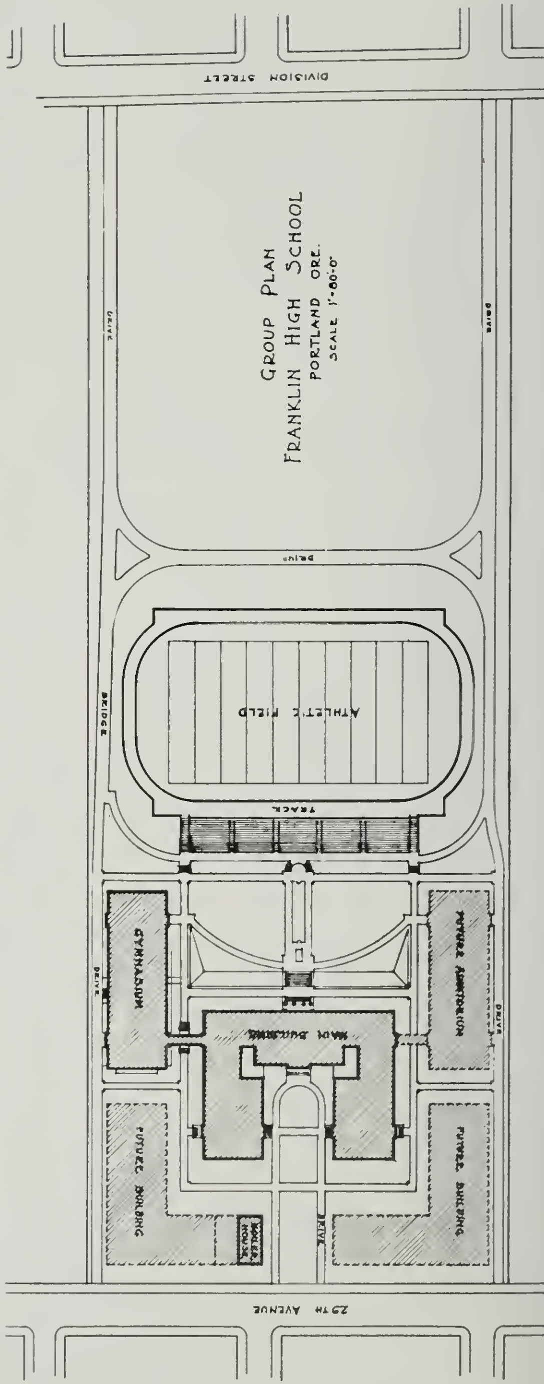


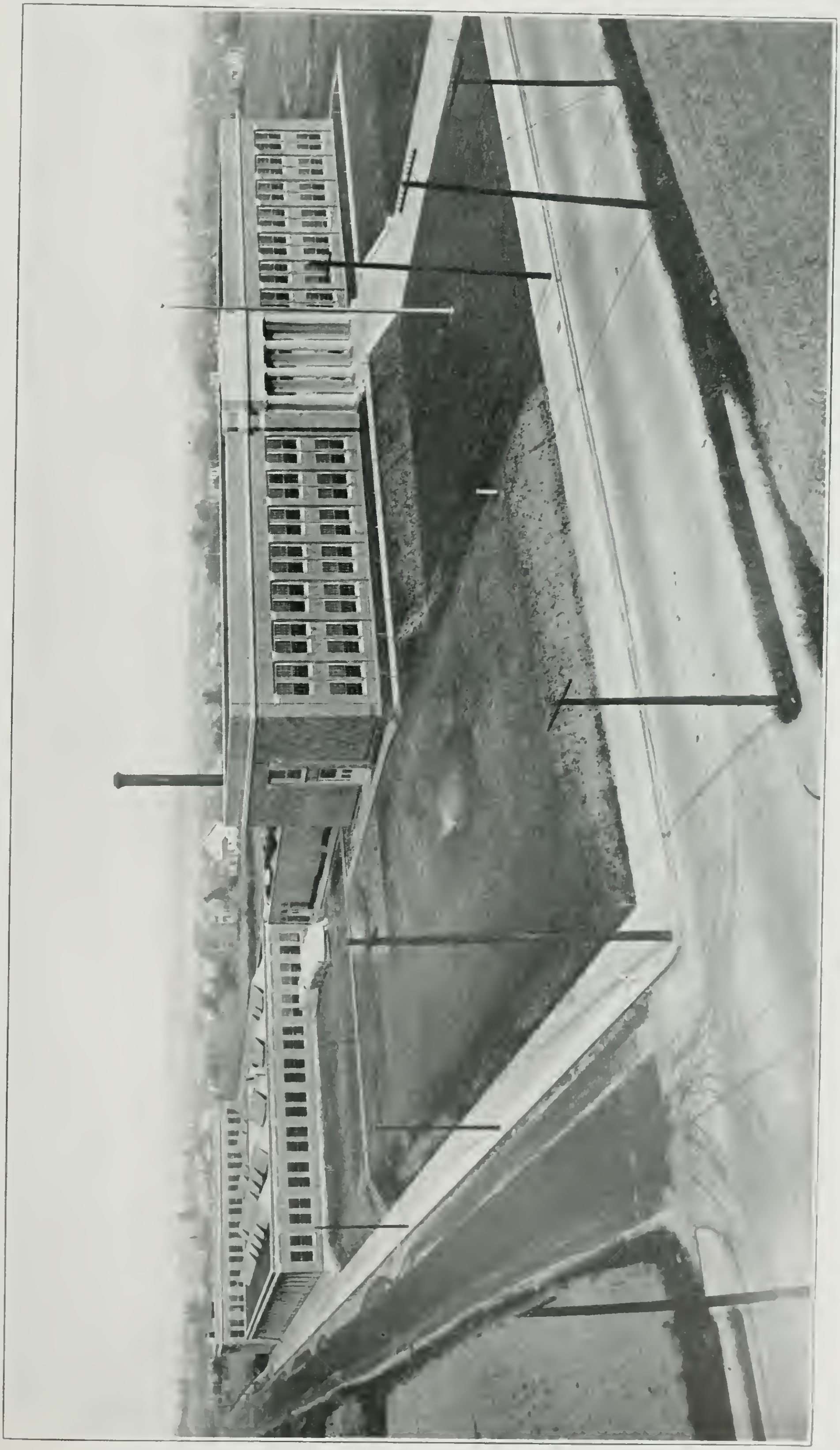
•PLAN• OF• BOILER• HOUSE•

FLOOR PLANS OF THE BENJAMIN FRANKLIN HIGH SCHOOL, PORTLAND, ORE.

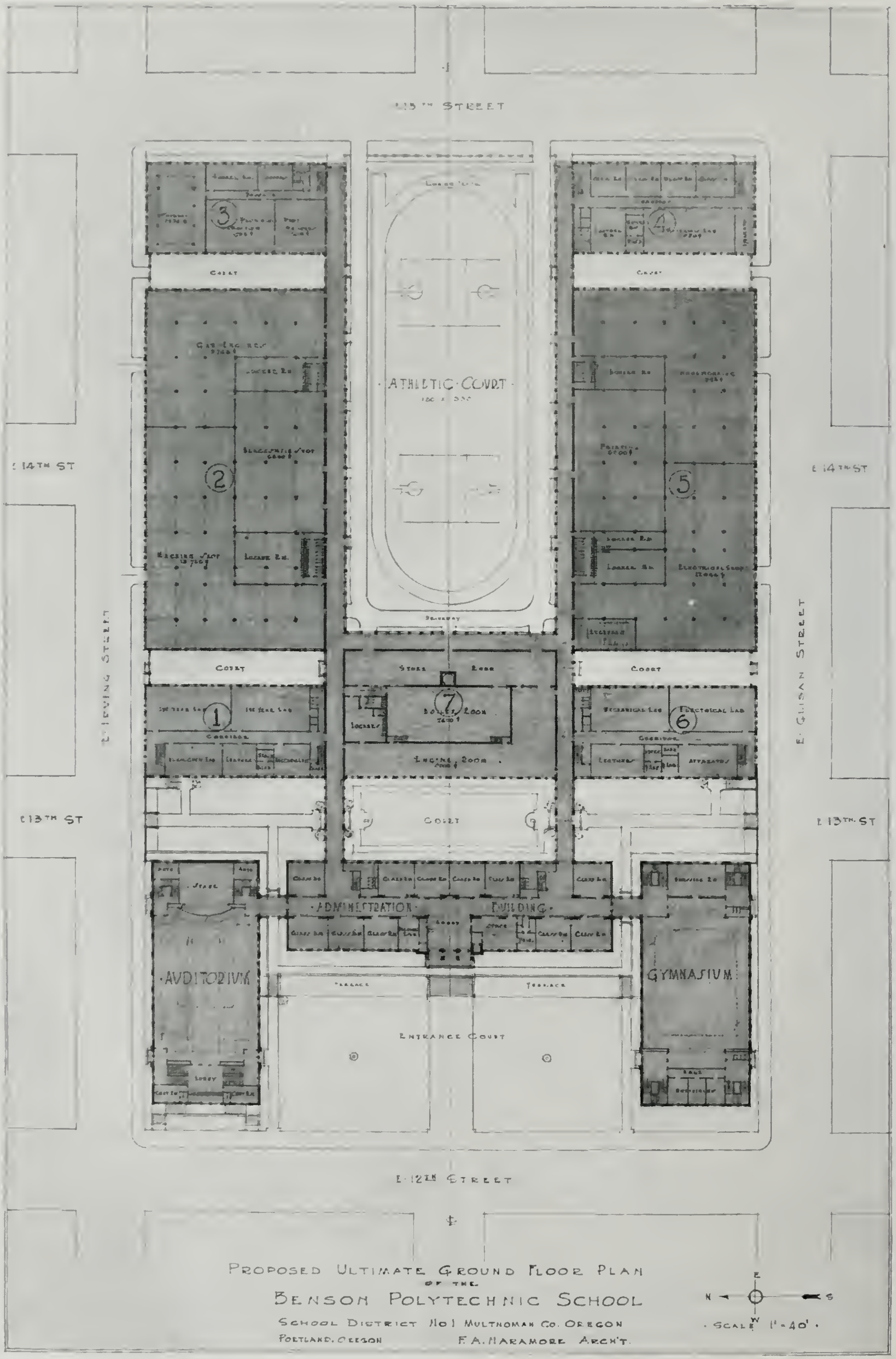
F. A. Naramore, Architect, Board of Education, Portland.

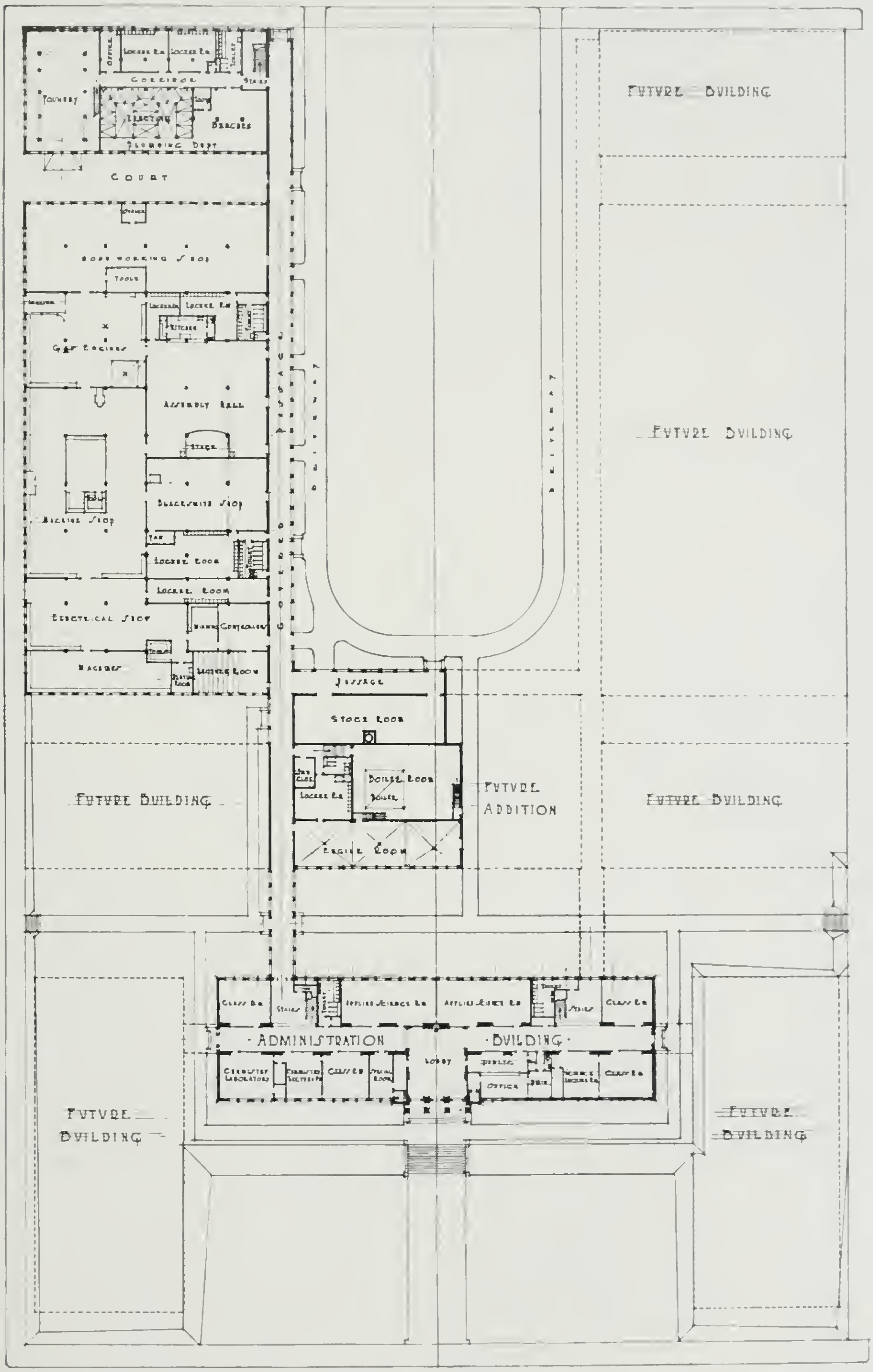

FRANKLIN HIGH SCHOOL PORTLAND OREGON
SCHOOL DISTRICT No 1 F. A. NARAMORE ARCHT.


DIVISION STREET
GROUP PLAN
FRANKLIN HIGH SCHOOL
PORTLAND ORE.
SCALE 1"=80'-0"
DRIVE
ATHLETIC FIELD
TRACK
BRIDGE
GYMNASIUM
MAIN BUILDING
FUTURE AUDITORIUM
FUTURE BUILDING
FUTURE BUILDING
29TH AVENUE

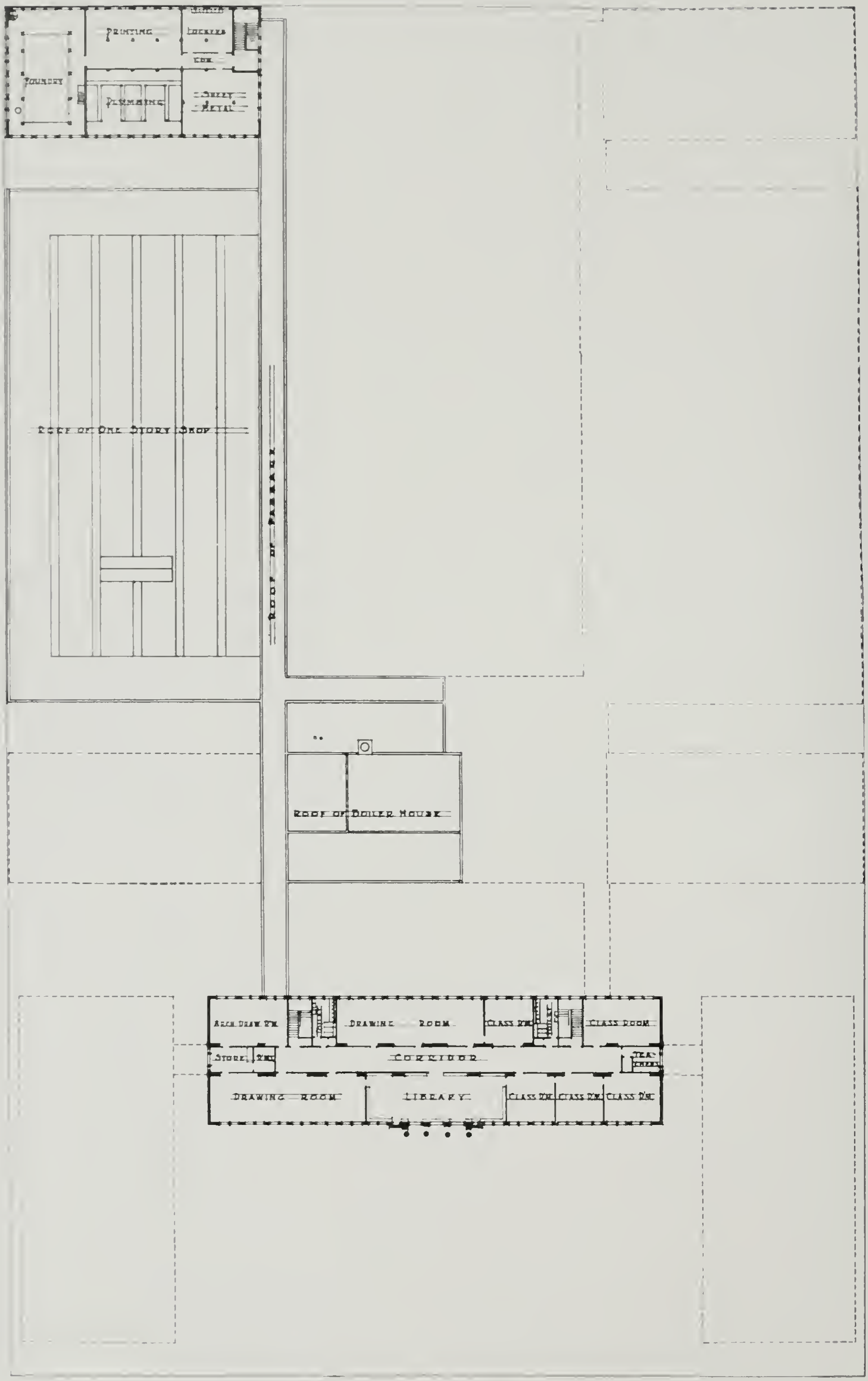


BENSON POLYTECHNIC HIGH SCHOOL, PORTLAND, ORE.
(View of First Unit.)
F. A. Naramore, Architect, Board of Education, Portland.

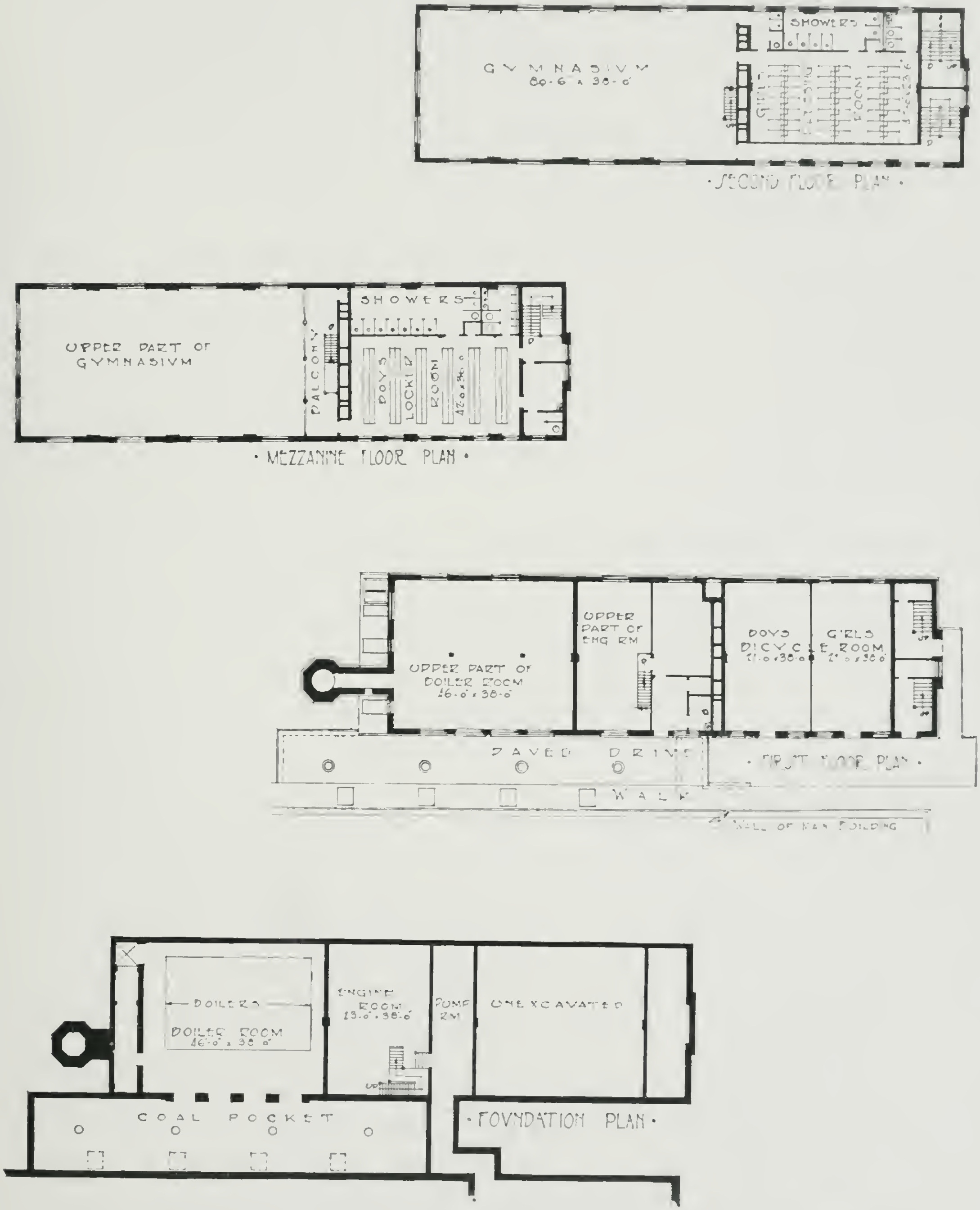

ATHLETIC COURT
COURT
STORE ROOM
BOILER ROOM
ENGINE ROOM
ADMINISTRATION BUILDING
AUDITORIUM
GYMNASIUM
ENTRANCE COURT
TERRACE
E 14TH ST
E 13TH ST
E 12TH STREET
E. IRVING STREET
E. GLISAN STREET
MECHANICAL LAB
ELECTRICAL LAB
LOCKER RM
PROPOSED ULTIMATE GROUND FLOOR PLAN
OF THE
BENSON POLYTECHNIC SCHOOL
SCHOOL DISTRICT NO 1 MULTNOMAH CO. OREGON
PORTLAND, OREGON
F. A. NARAMORE ARCH'T.
SCALE 1" = 40'
N
S
E
W



PRESENT FIRST FLOOR PLAN, BENSON POLYTECHNIC HIGH SCHOOL, PORTLAND, ORE.
F. A. Naramore, Architect, Board of Education, Portland.

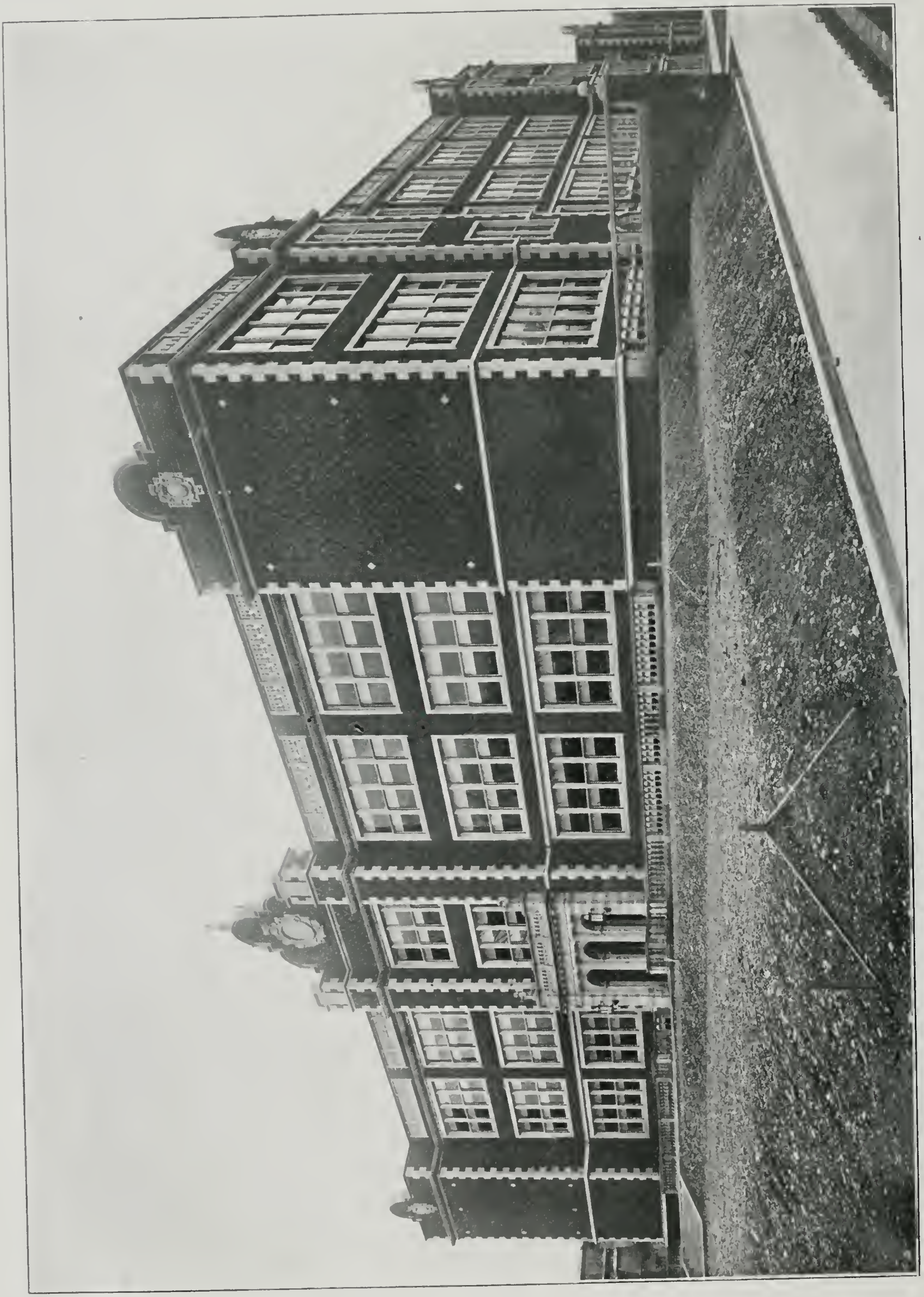


SECOND FLOOR PLAN, BENSON POLYTECHNIC HIGH SCHOOL, PORTLAND, ORE.
F. A. Naramore, Architect, Board of Education, Portland.

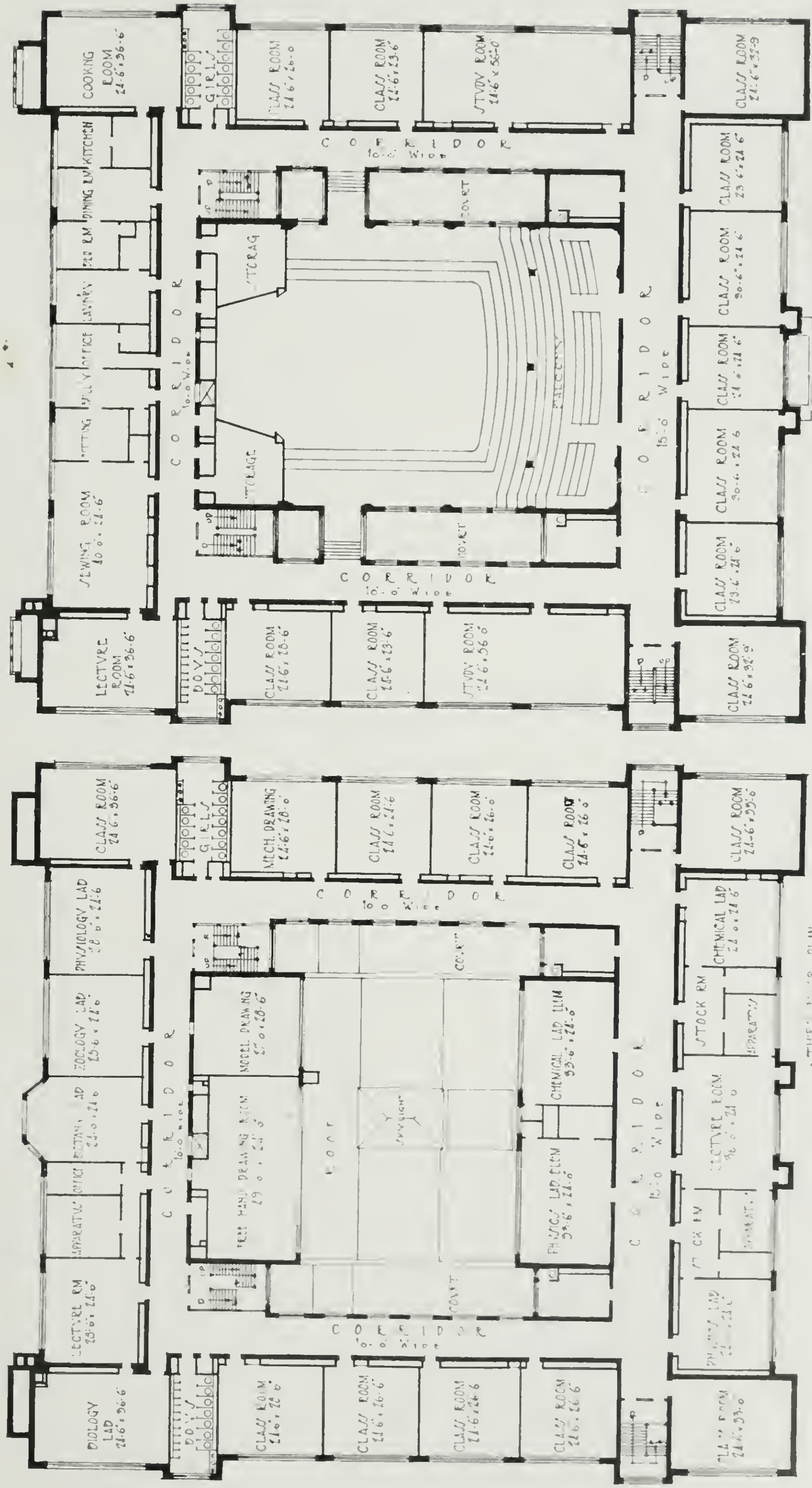


FLOOR PLANS OF THE POWER PLANT AND GYMNASIUM BUILDING, HIGH SCHOOL, BINGHAMTON, N. Y.

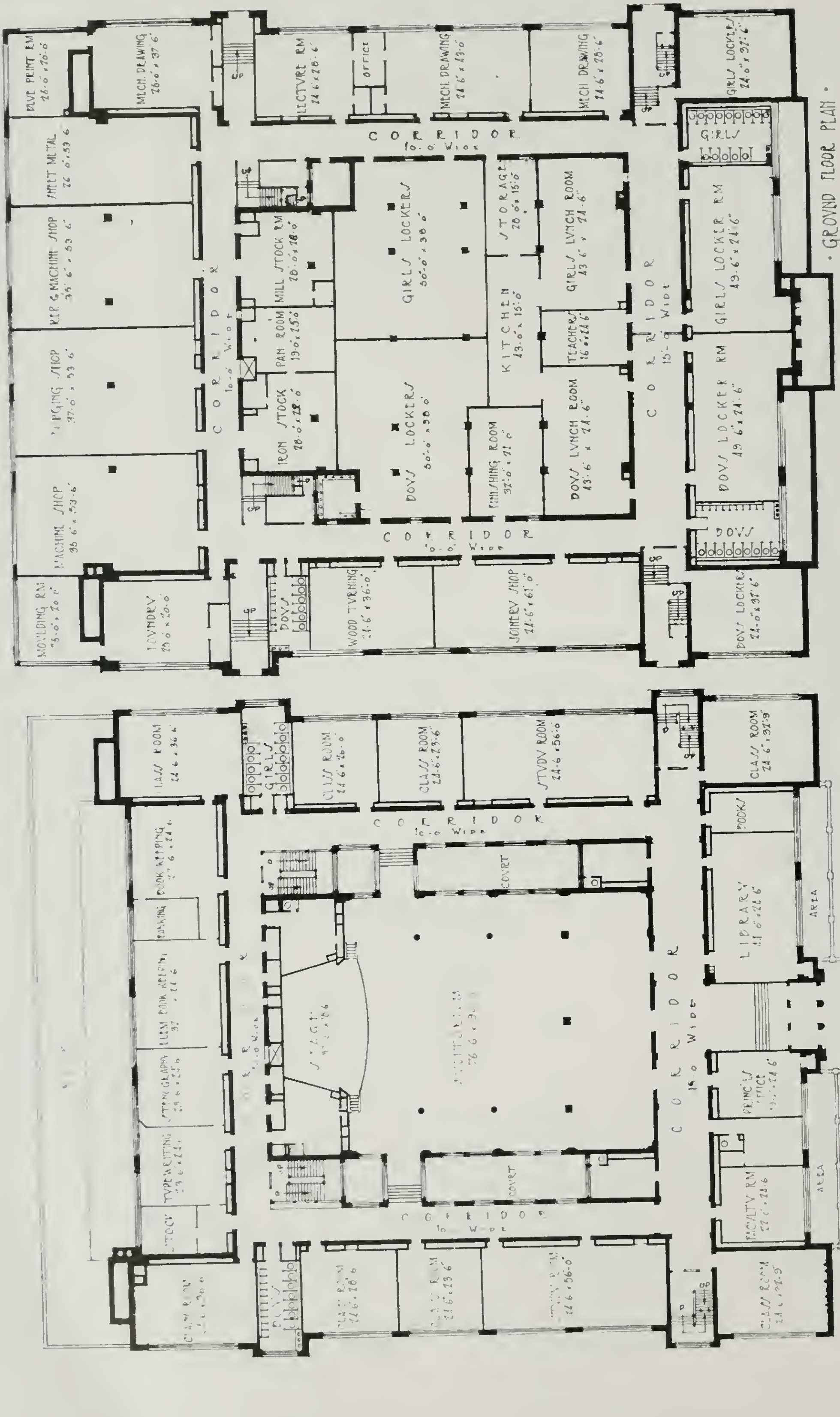
C. E. Vosbury, Architect, Binghamton



HIGH SCHOOL, BINGHAMTON, N. Y.
C. E. Vosbury, Architect, Binghamton.

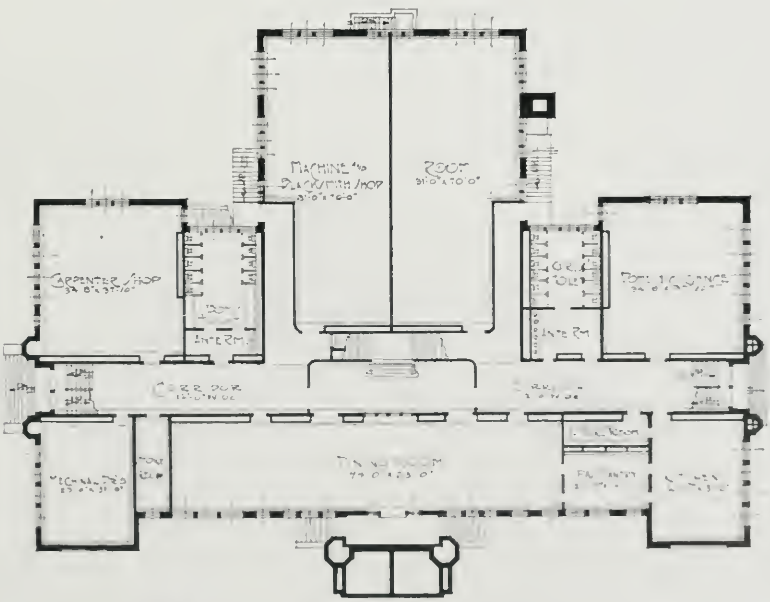


FLOOR PLANS OF THE HIGH SCHOOL, BINGHAMTON, N. Y.



FLOOR PLANS, HIGH SCHOOL, BINGHAMTON, N. Y.
C. E. Vosbury, Architect, Binghamton.

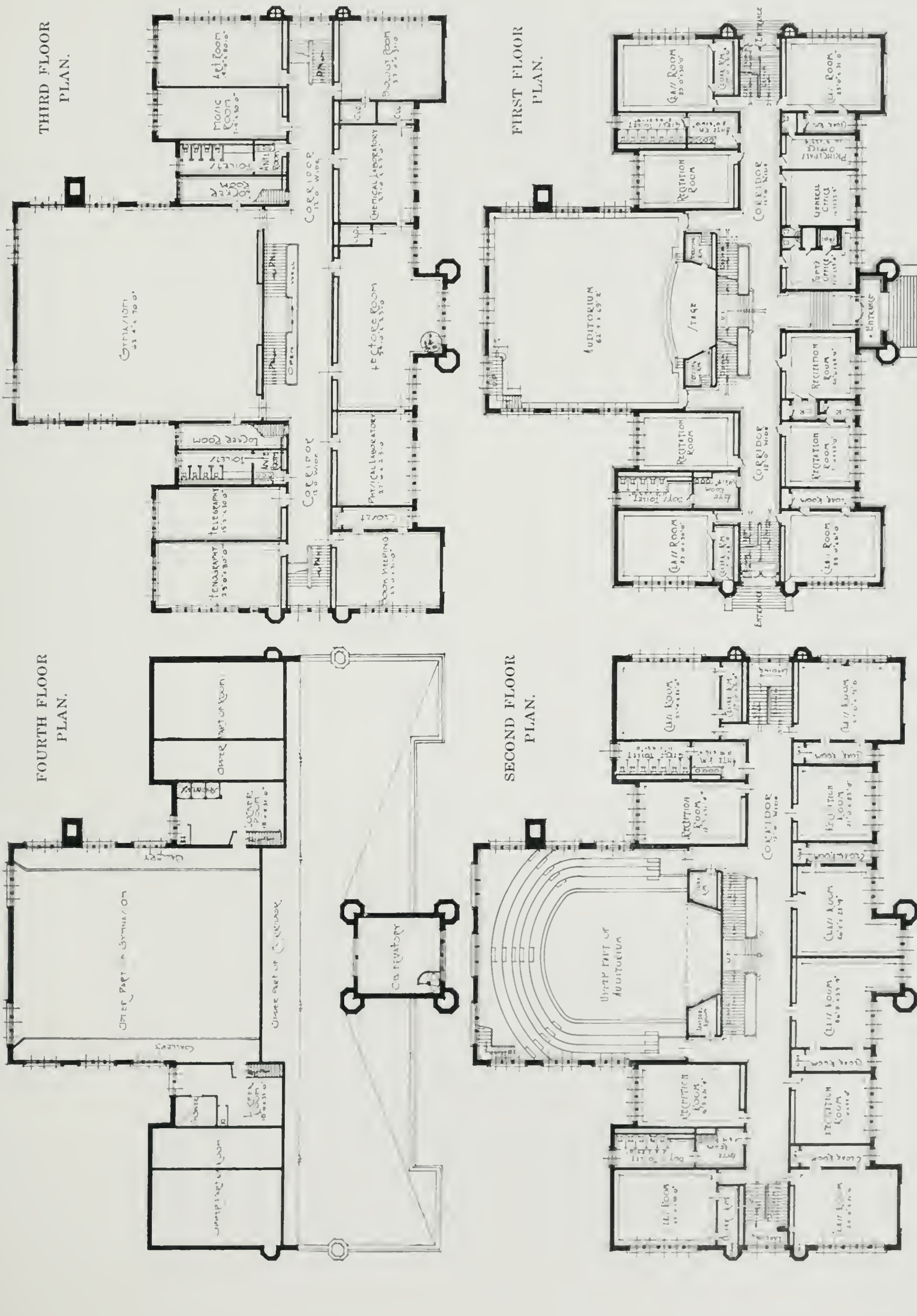
AUDITORIUM, HIGH SCHOOL, HOT SPRINGS, ARK.



BASEMENT PLAN, HIGH SCHOOL, HOT SPRINGS, ARK.

Sanguinet & Staats, Architects, Fort Worth, Tex.

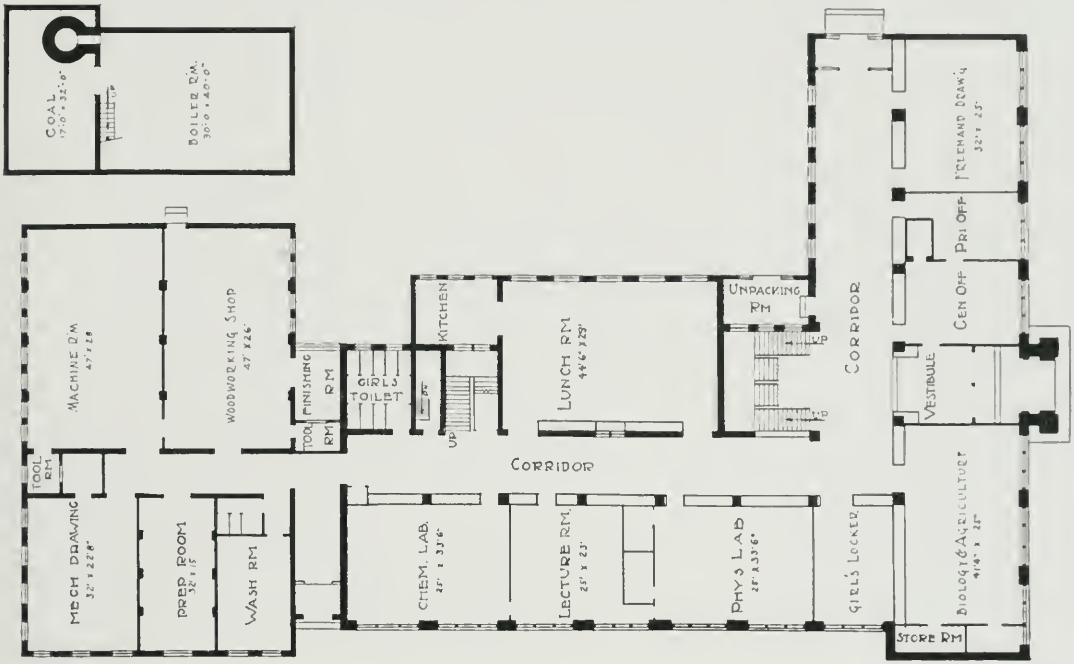
HIGH SCHOOL, HOT SPRINGS, ARK.
Sanguinet & Staats, Architects, Fort Worth, Tex.



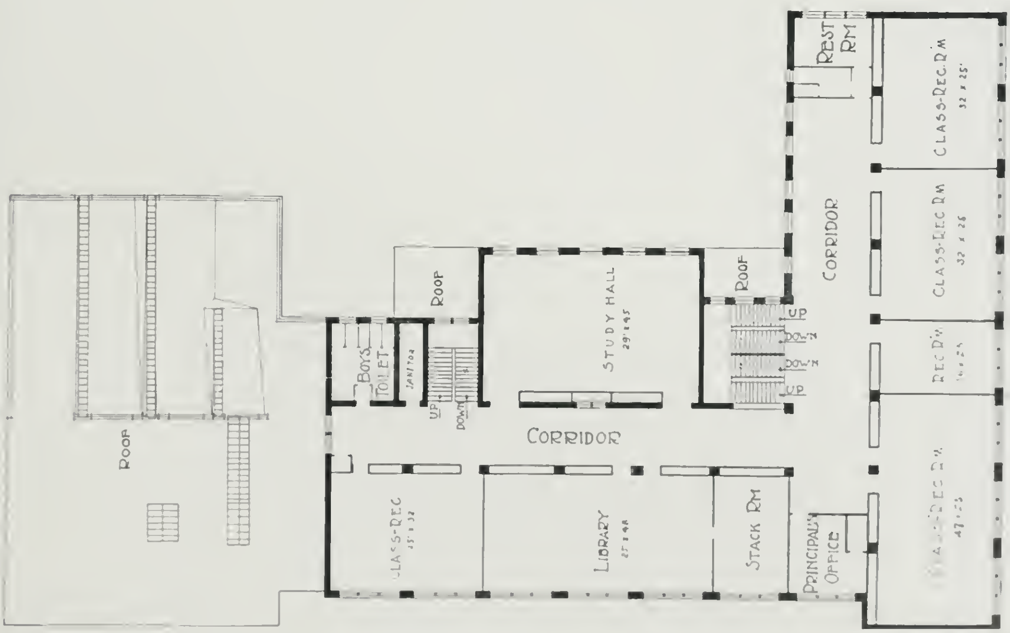
FLOOR PLANS, HIGH SCHOOL, HOT SPRINGS, ARK.

HIGH SCHOOL, YPSILANTI, MICH.

Robinson & Campau, Architects, Grand Rapids, Mich.



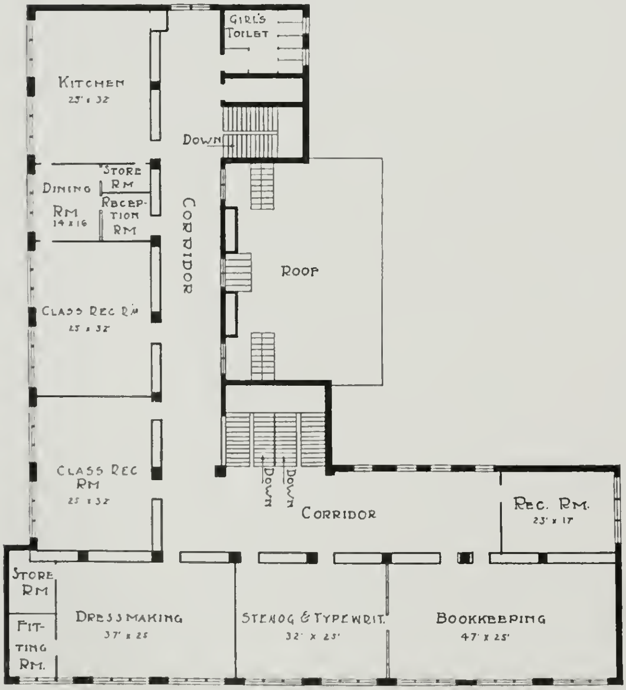
FIRST FLOOR PLAN.



SECOND FLOOR PLAN.

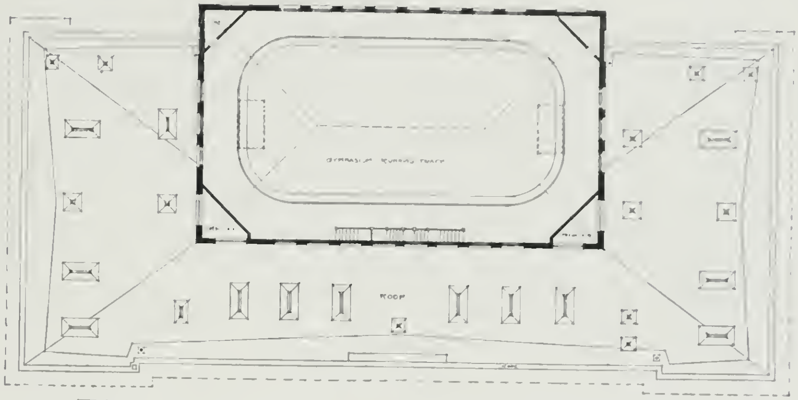
FLOOR PLANS, HIGH SCHOOL, YPSILANTI, MICH.

A GOOD TYPE OF SEWING ROOM FOR A HIGH SCHOOL
SEWING CLASSROOM, HIGH SCHOOL, YPSILANTI, MICH.

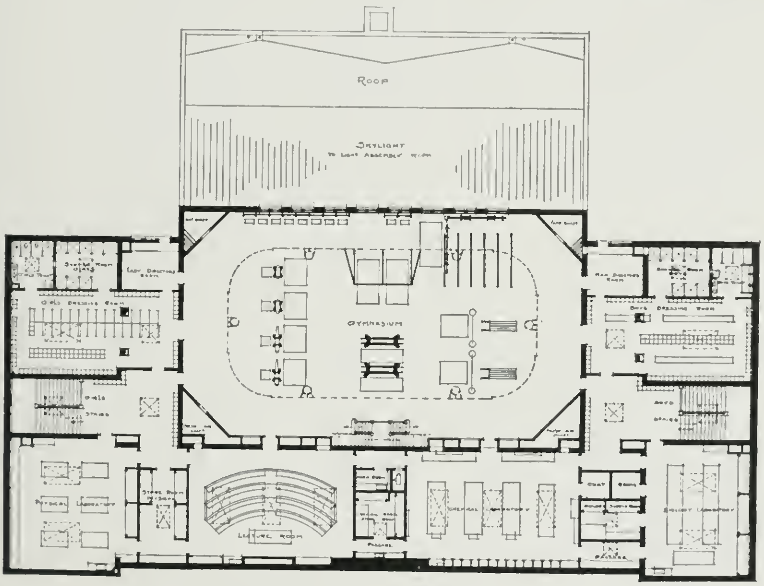


THIRD FLOOR PLAN.

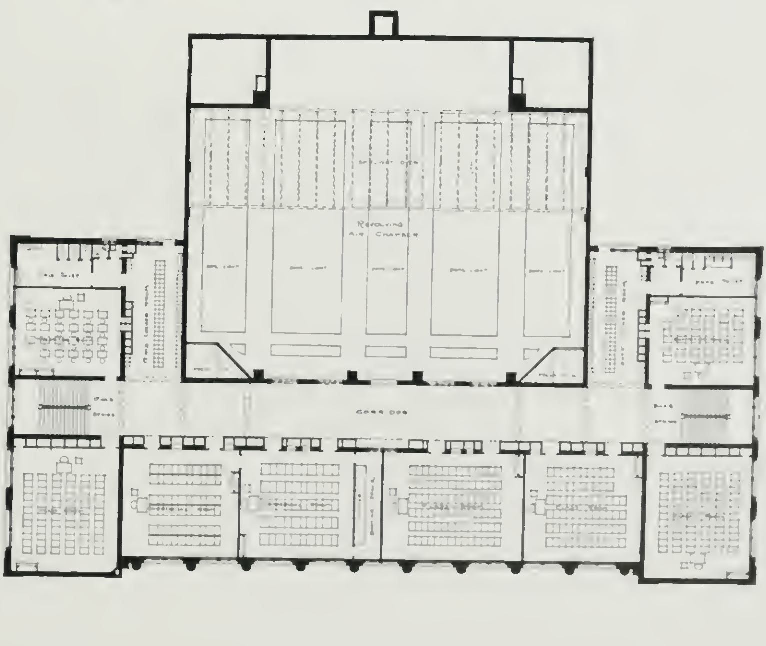
FLOOR PLAN, HIGH SCHOOL,
YPSILANTI, MICH.



FIFTH FLOOR PLAN,
HIGH SCHOOL,
BLOOMFIELD, N. J.

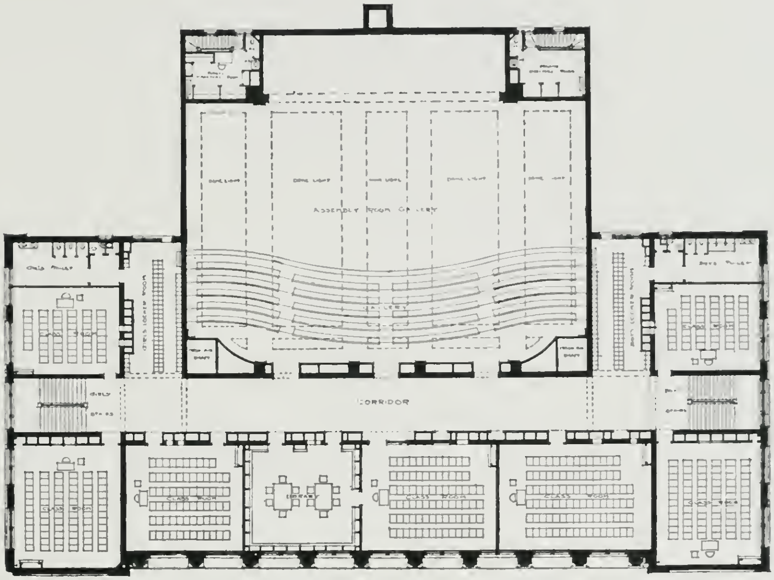


FOURTH FLOOR PLAN,
HIGH SCHOOL,
BLOOMFIELD, N. J.

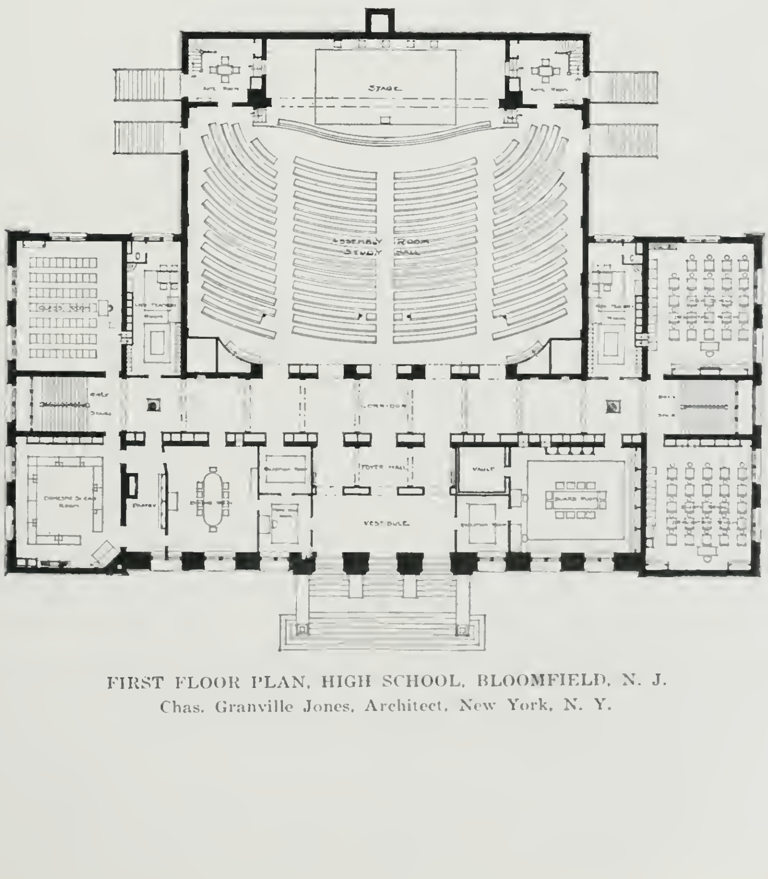


THIRD FLOOR PLAN,
HIGH SCHOOL,
BLOOMFIELD, N. J.

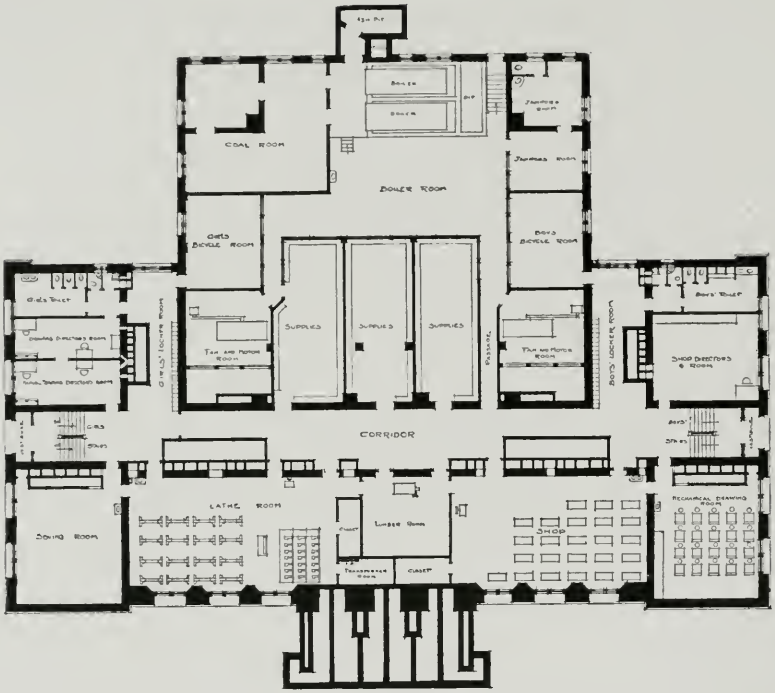
HIGH SCHOOL, BLOOMFIELD, N. J.
C. Granville Jones, Architect, New York, N. Y.



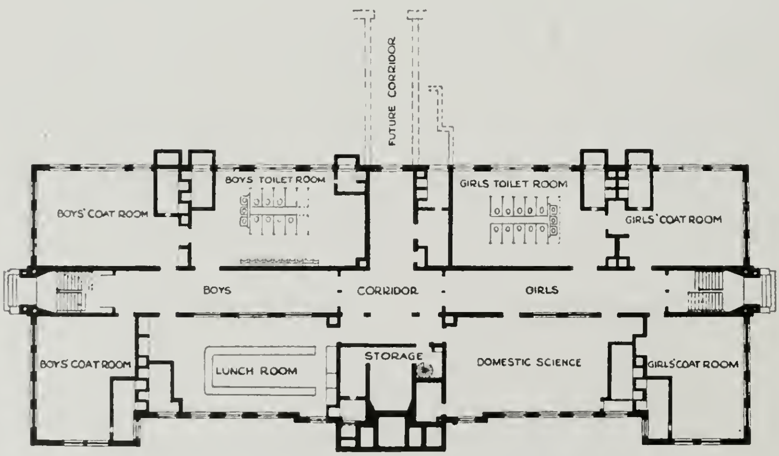
SECOND FLOOR PLAN, HIGH SCHOOL, BLOOMFIELD, N. J.



FIRST FLOOR PLAN, HIGH SCHOOL, BLOOMFIELD, N. J.
Chas. Granville Jones, Architect, New York, N. Y.



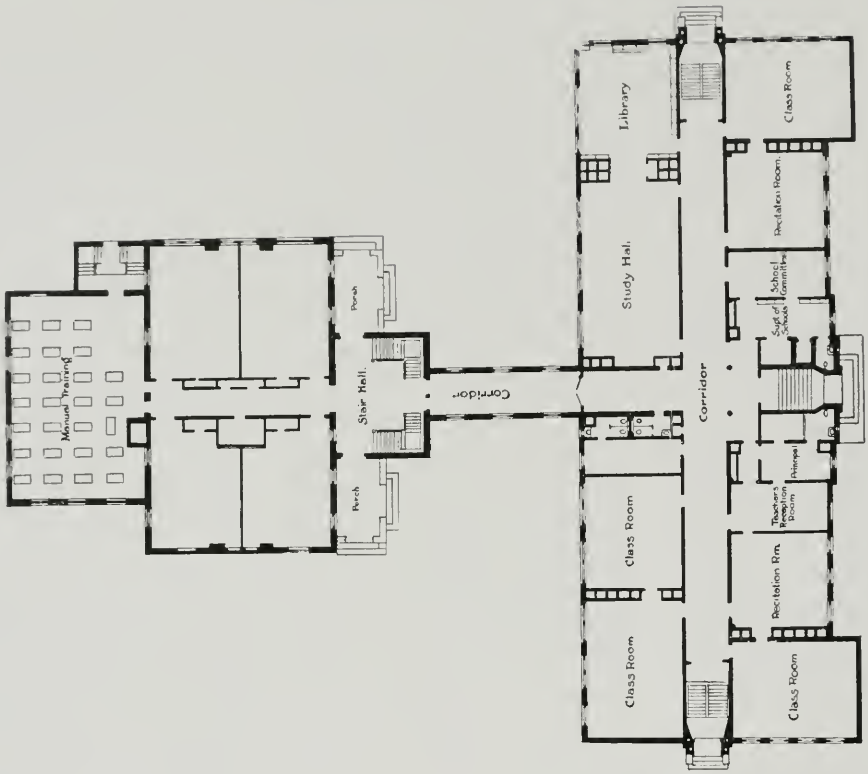
BASEMENT PLAN, HIGH SCHOOL, BLOOMFIELD, N. J.



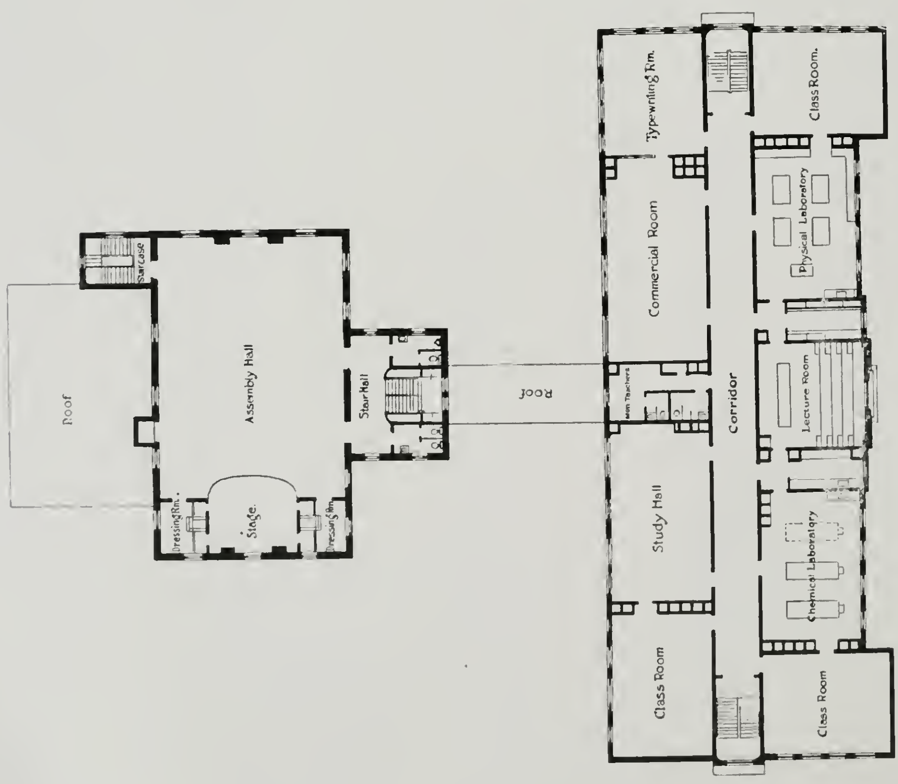
BASEMENT PLAN, HIGH SCHOOL, ANDOVER, MASS.

Fisher, Ripley & Le Boutillier, Architects, Boston.

HIGH SCHOOL, ANDOVER, MASS.
Fisher, Ripley & Le Boutillier, Architects, Boston.



FIRST FLOOR PLAN.

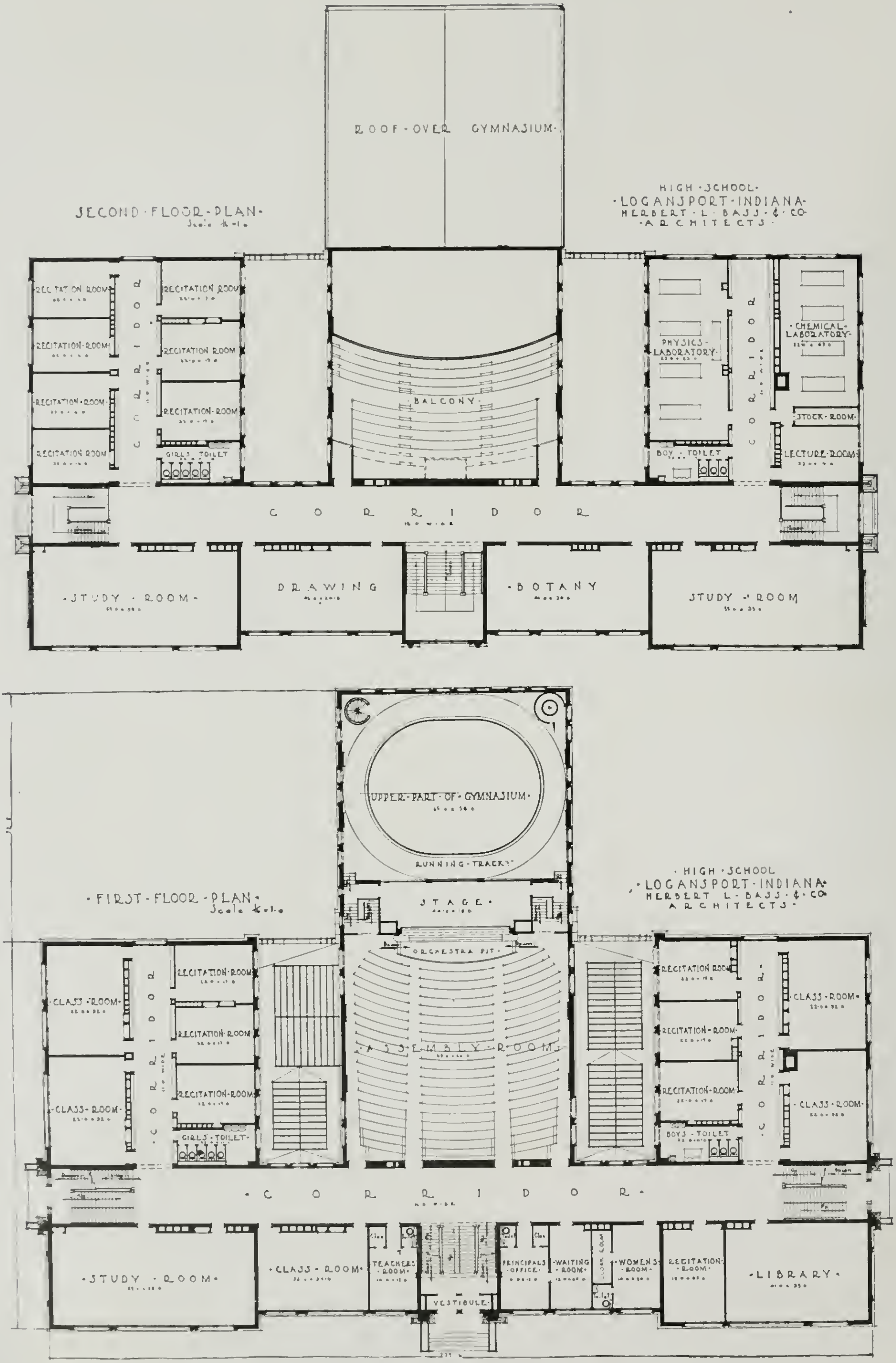


SECOND FLOOR PLAN.

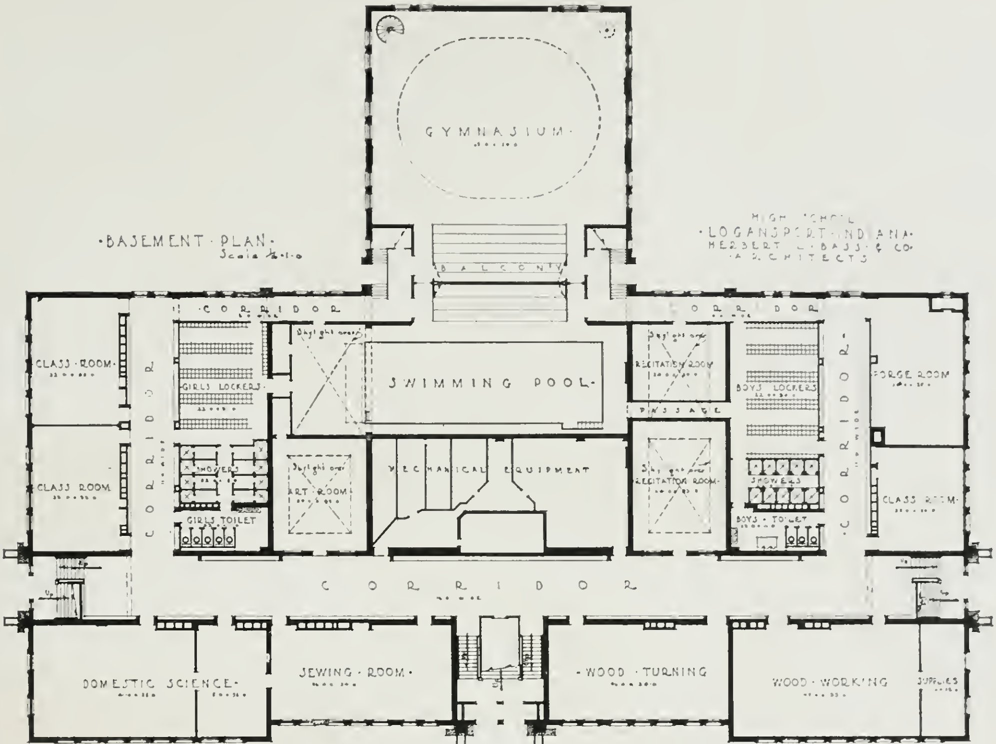
FLOOR PLANS, HIGH SCHOOL, ANDOVER, MASS.

(The rear building is old and is to be replaced at a future date.)

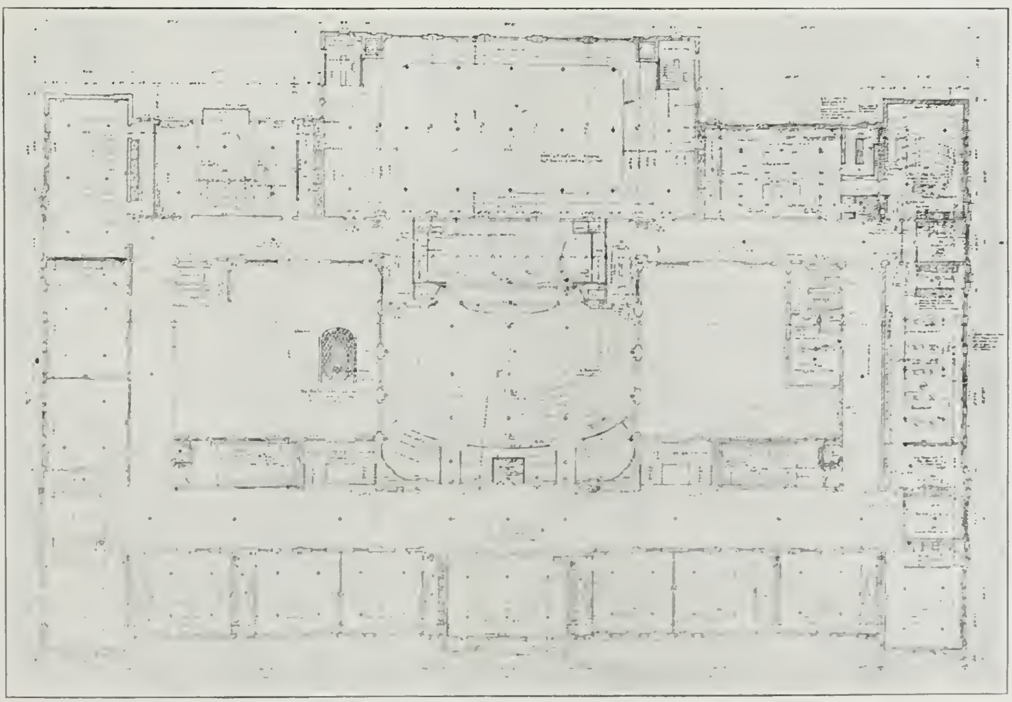
LOGANSPORT HIGH SCHOOL, LOGANSPORT, IND.
Herbert L. Bass & Co., Architects, Indianapolis, Ind.



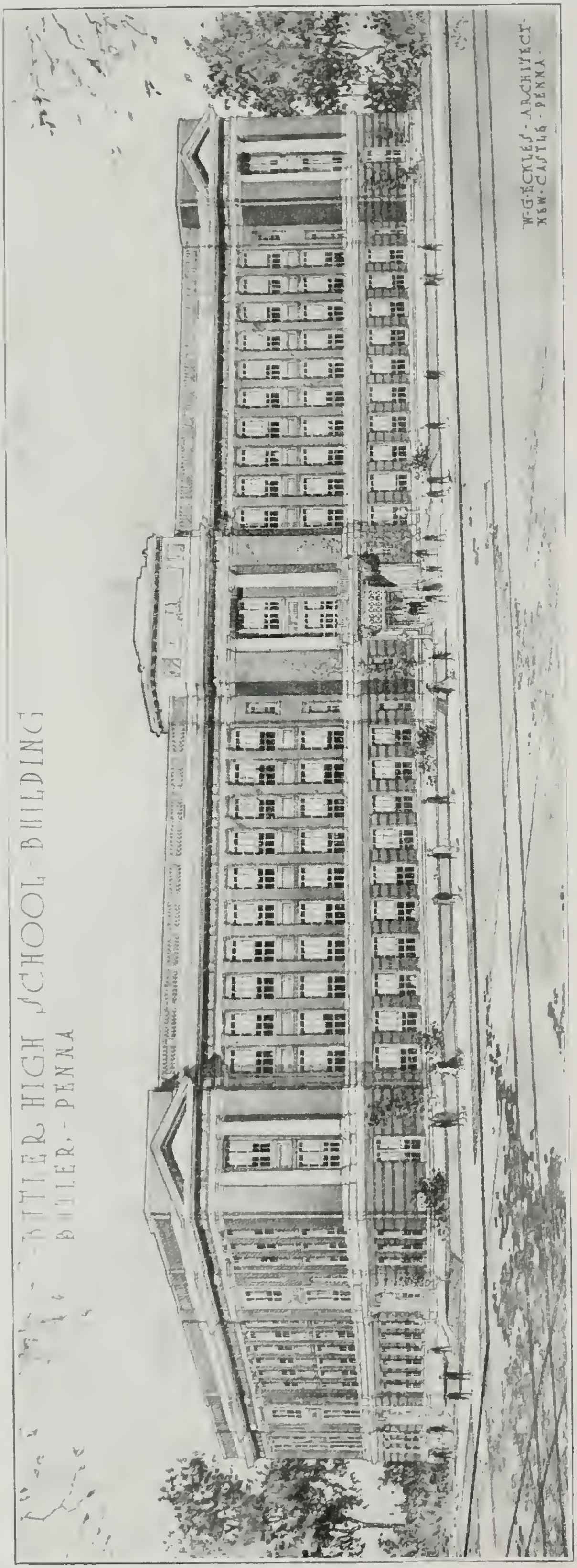
FLOOR PLANS, LOGANSPORT HIGH SCHOOL.



BASEMENT PLAN, LOGANSPORT HIGH SCHOOL.

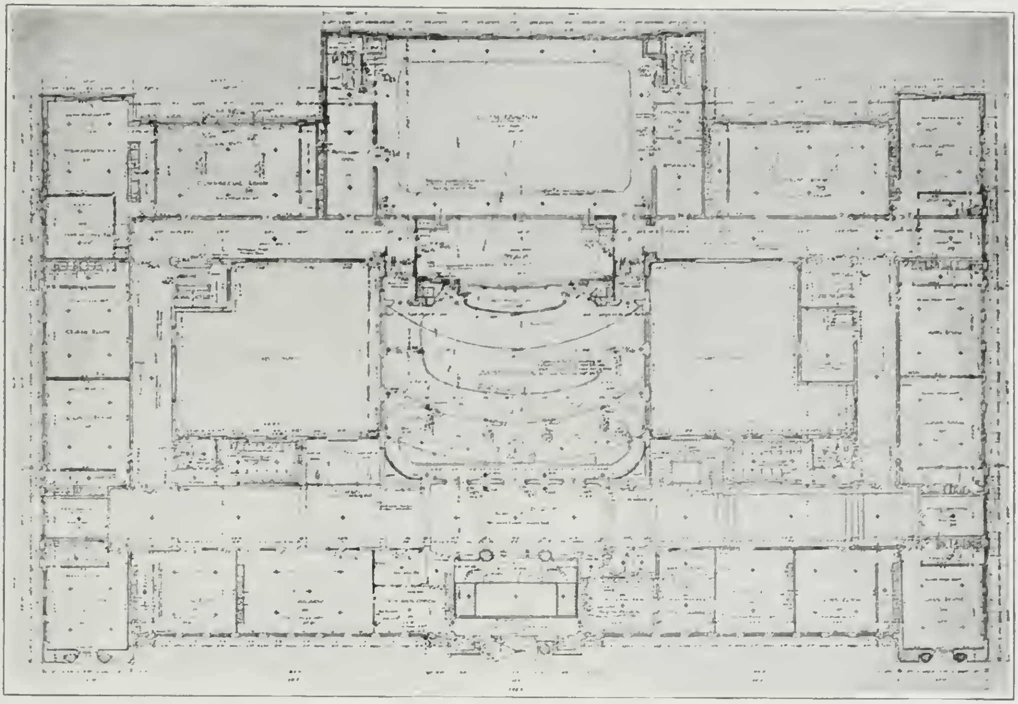


THIRD FLOOR PLAN, HIGH SCHOOL, BUTLER, PA.

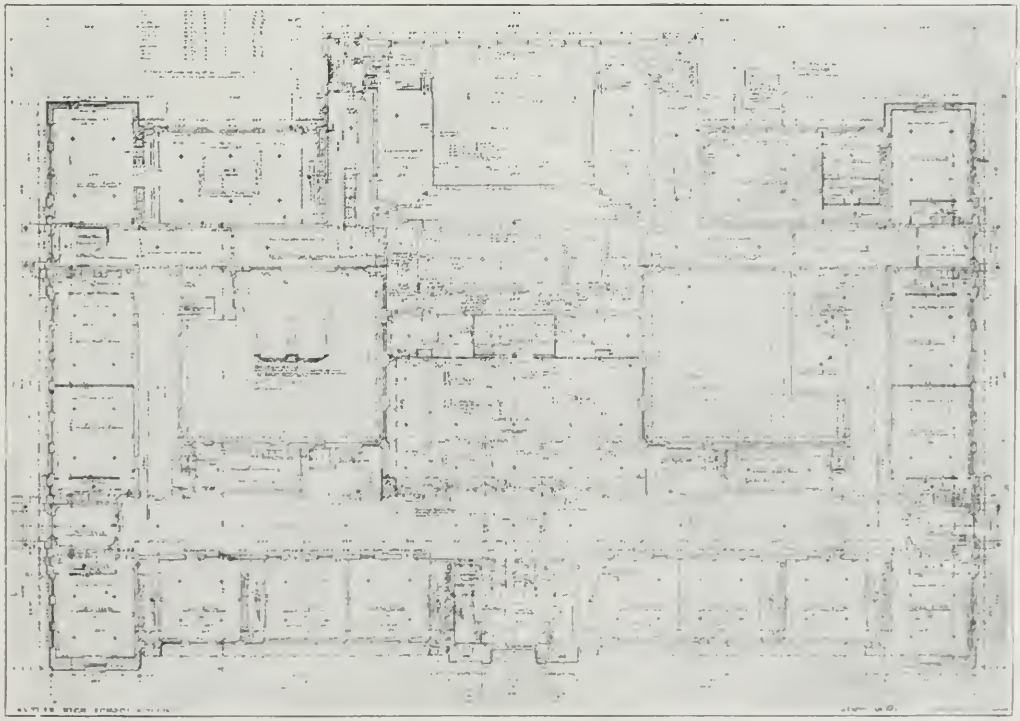


HIGH SCHOOL, BUTLER, PA.

W. G. Eckles, Architect, New Castle, Pa.

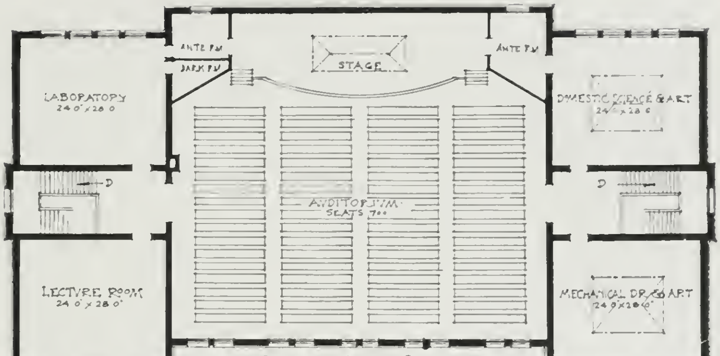


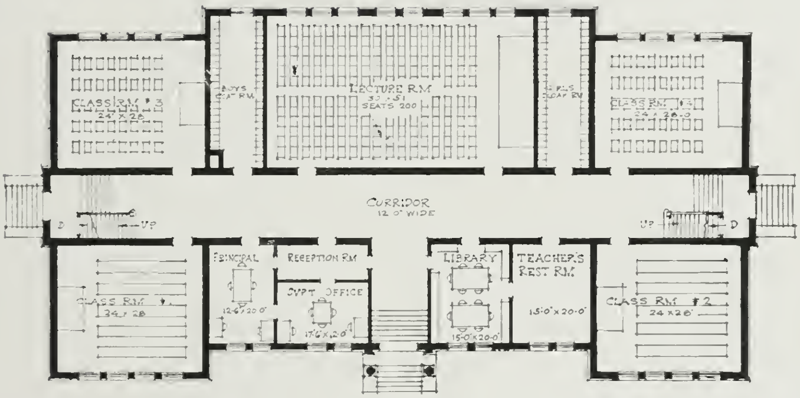
SECOND FLOOR PLAN, HIGH SCHOOL, BUTLER, PA.



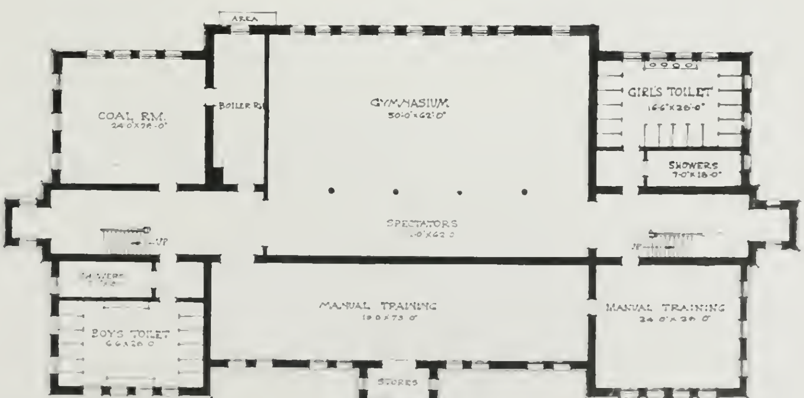
FIRST FLOOR PLAN, HIGH SCHOOL, BUTLER, PA.
W. G. Eckles, Architect, New Castle, Pa.

HIGH SCHOOL, SELMA, ALA.
W. T. Warren, Architect, Birmingham, Ala.





·FIRST· FLOOR·PLAN·

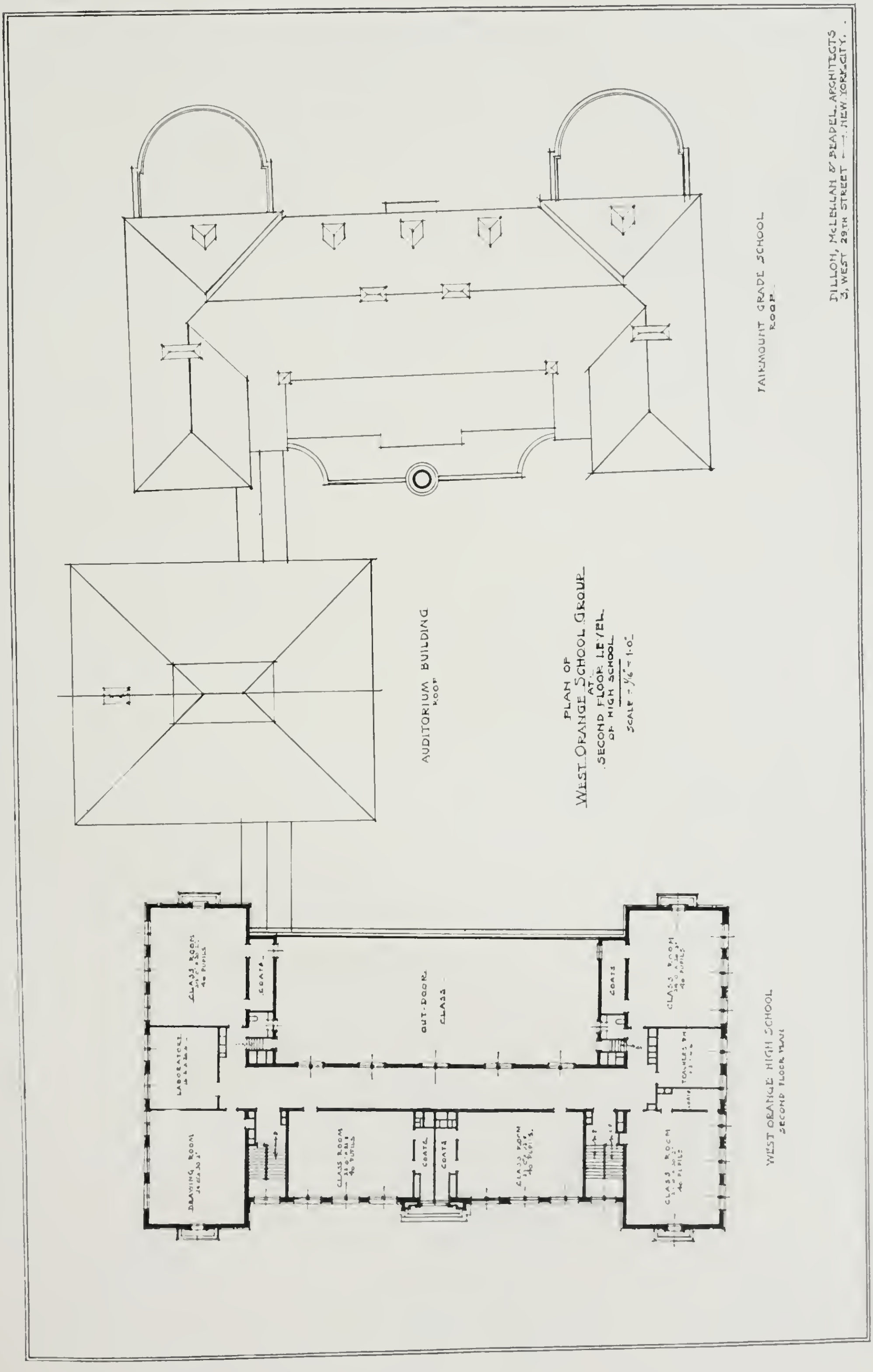


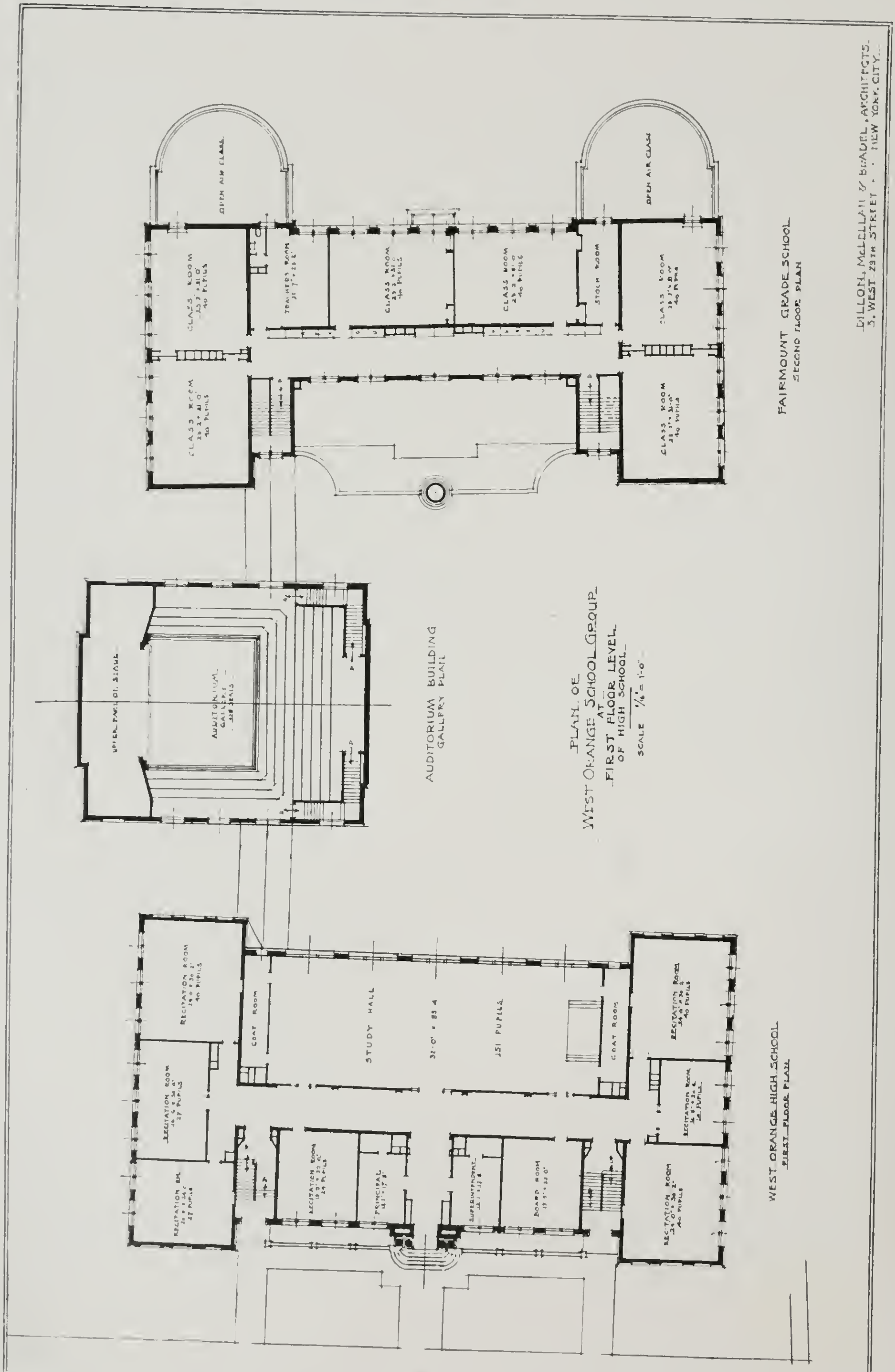
··BASEMENT·PLAN·

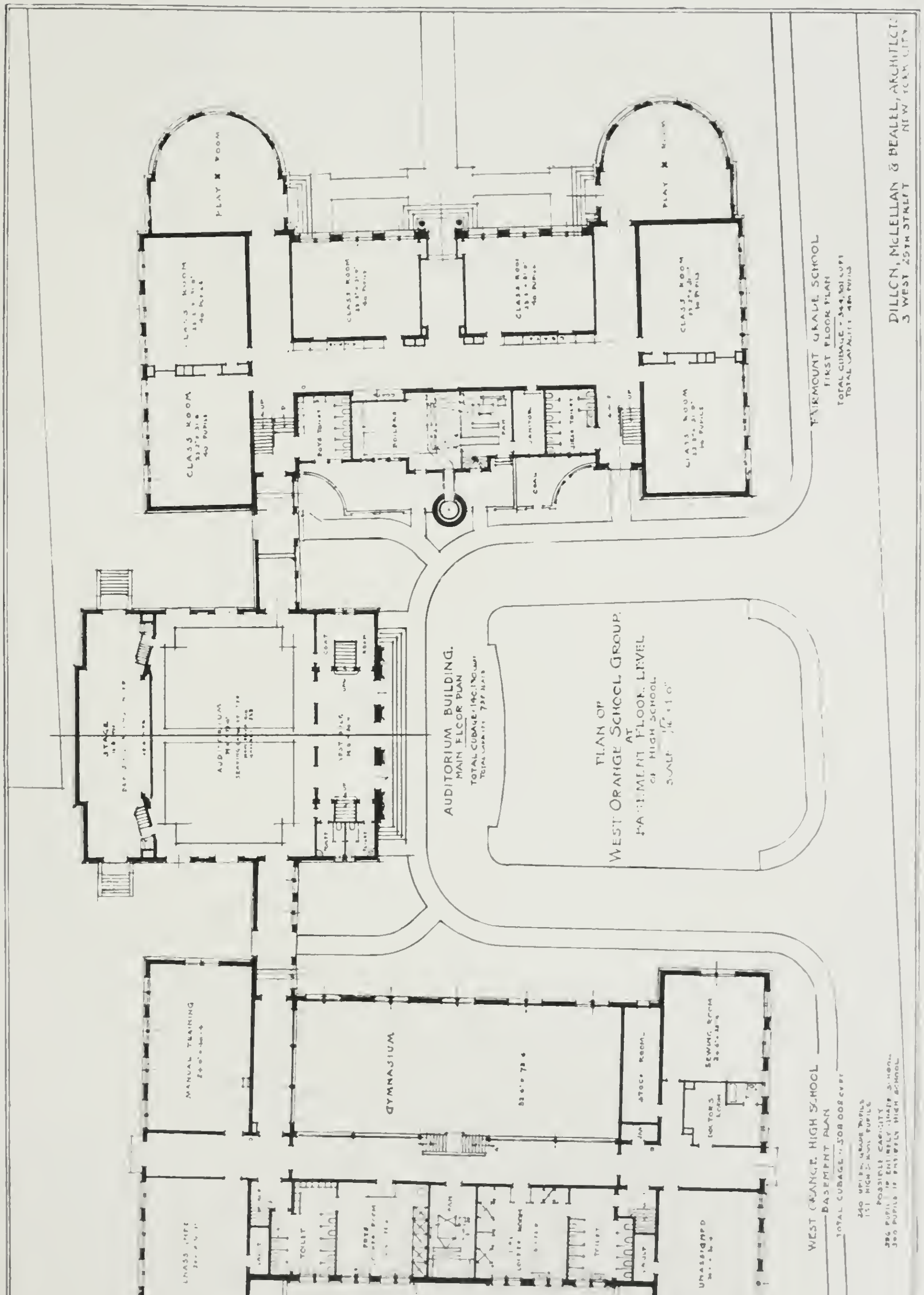
FLOOR PLANS, HIGH SCHOOL, SELMA, ALA.

W. T. Warren, Architect, Birmingham, Ala.

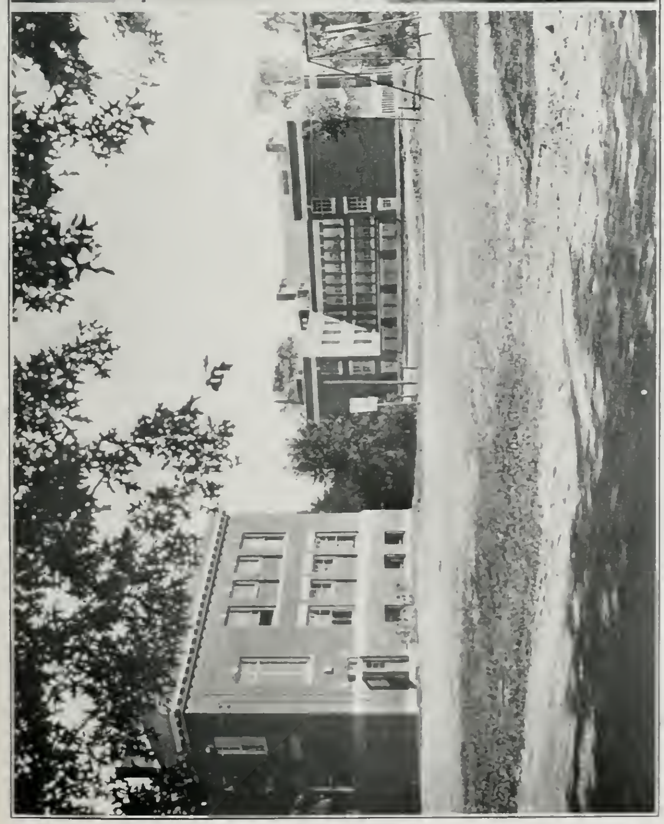
HIGH SCHOOL, WEST ORANGE, N. J.
Dillon, McLellan & Beadel, Architects, New York, N. Y.

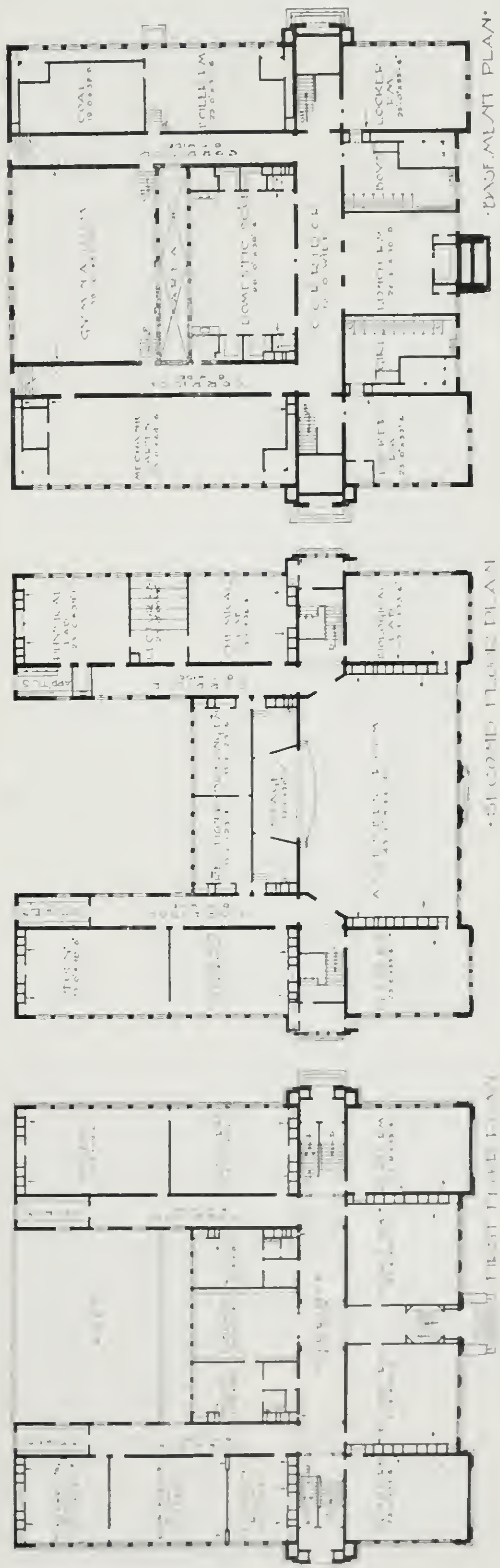

DILLON, McLELLAN & BEADEL, ARCHITECTS
3, WEST 29TH STREET NEW YORK CITY
FAIRMOUNT GRADE SCHOOL
ROOF
AUDITORIUM BUILDING
ROOF
PLAN OF
WEST ORANGE SCHOOL GROUP
AT
SECOND FLOOR LEVEL
OF HIGH SCHOOL
SCALE = 1/16" = 1'-0"
WEST ORANGE HIGH SCHOOL
SECOND FLOOR PLAN
OUT-DOOR CLASS
CLASS ROOM
LABORATORY
DRAWING ROOM
COATS


PLAN OF
WEST ORANGE SCHOOL GROUP
AT
FIRST FLOOR LEVEL
OF HIGH SCHOOL
SCALE 1/16" = 1'-0"
FAIRMOUNT GRADE SCHOOL
SECOND FLOOR PLAN
AUDITORIUM BUILDING
GALLERY PLAN
WEST ORANGE HIGH SCHOOL
FIRST FLOOR PLAN
STUDY HALL
151 PUPILS
COAT ROOM
OPEN AIR CLASS
DILLON, McLELLAN & BEADEL, ARCHITECTS.
3 WEST 29TH STREET - NEW YORK CITY.

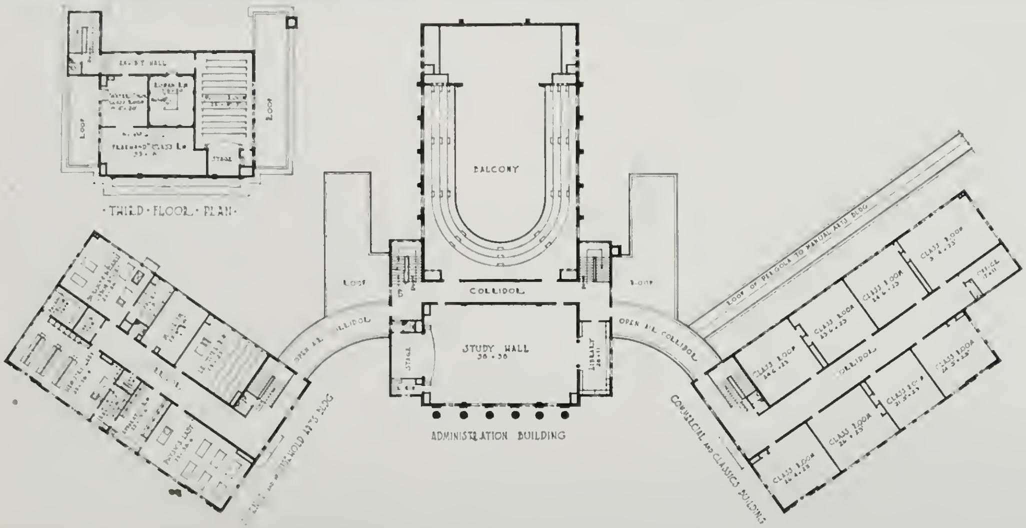

PLAY ROOM
CLASS ROOM
FAIRMOUNT GRADE SCHOOL
FIRST FLOOR PLAN
DILLON, McLELLAN & BEADEL, ARCHITECTS
3 WEST 29TH STREET
NEW YORK CITY
STAGE
AUDITORIUM
AUDITORIUM BUILDING.
MAIN FLOOR PLAN
PLAN OF
WEST ORANGE SCHOOL GROUP
AT
BASEMENT FLOOR LEVEL
OF HIGH SCHOOL
MANUAL TRAINING
GYMNASIUM
STOCK ROOM
SEWING ROOM
UNASSIGNED
TOILET
WEST ORANGE HIGH SCHOOL
BASEMENT PLAN

HIGH SCHOOL, AMHERST, MASS.
Clarence P. Hoyt, Architect, Boston, Mass.





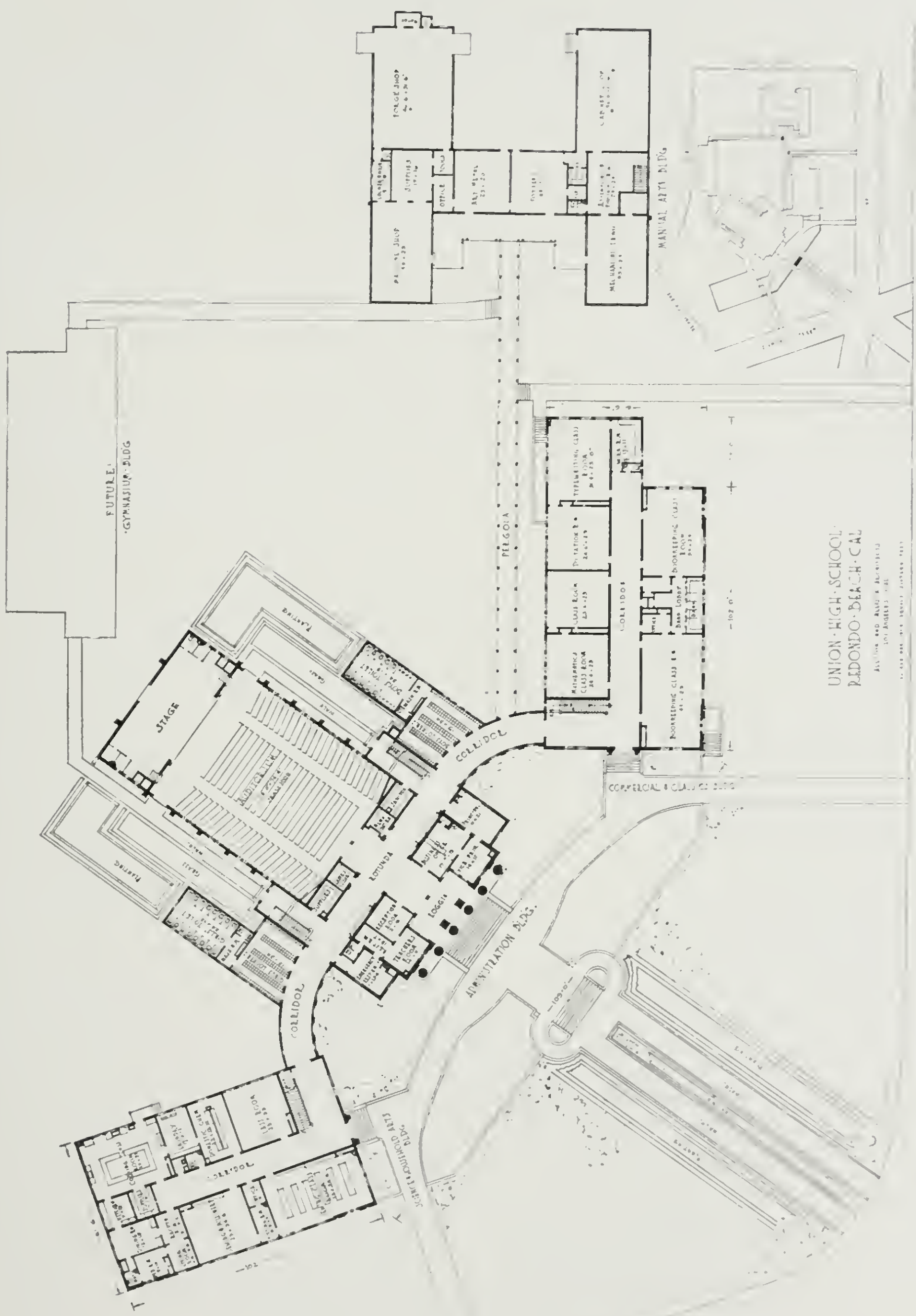
PLANS AND VIEWS OF THE HIGH SCHOOL, AMHERST, MASS.



UNION HIGH SCHOOL, REDONDO BEACH, CAL.

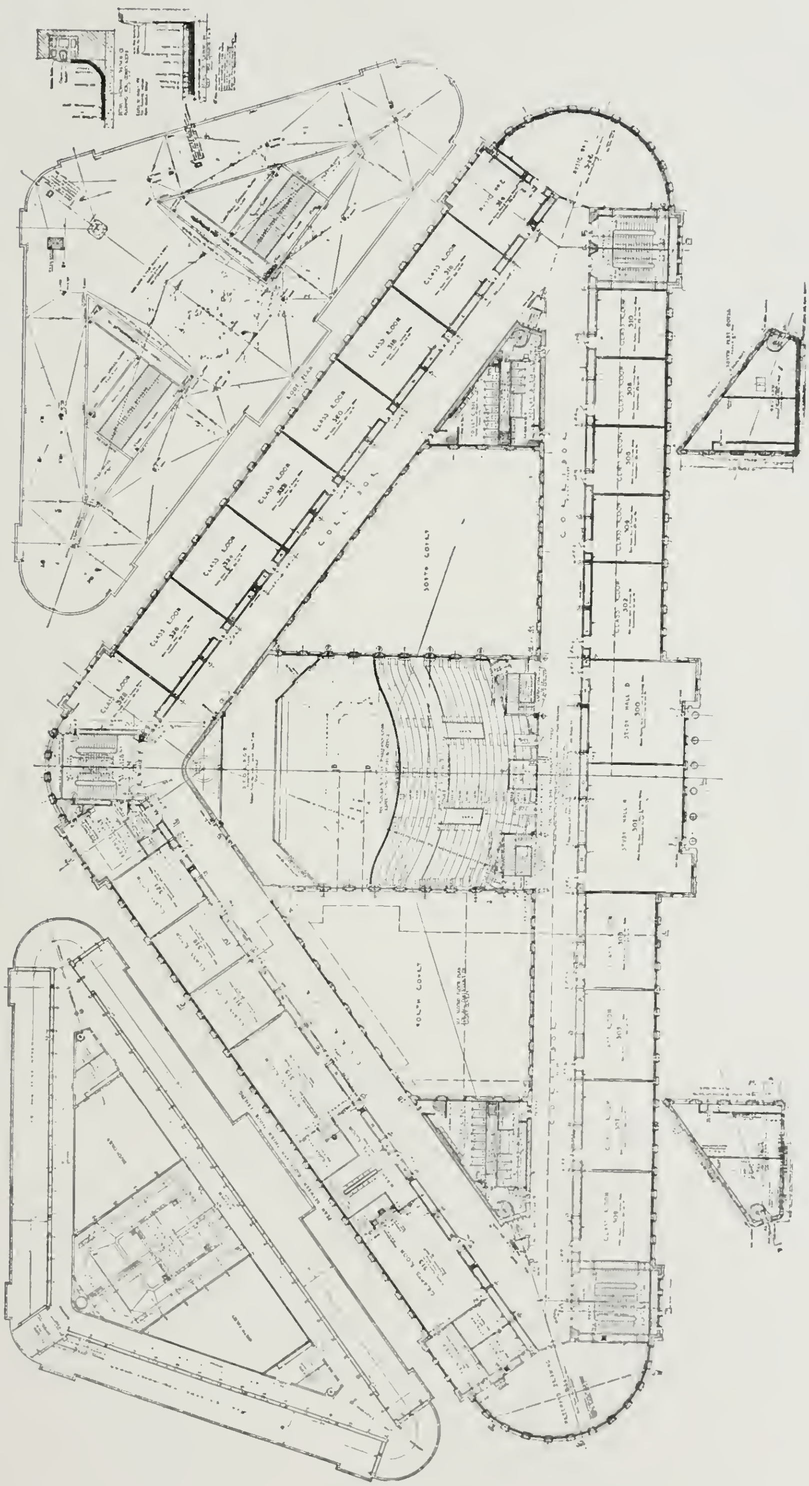
Allison & Allison, Architects, Los Angeles, Cal.

LEFT: SECOND FLOOR PLAN.

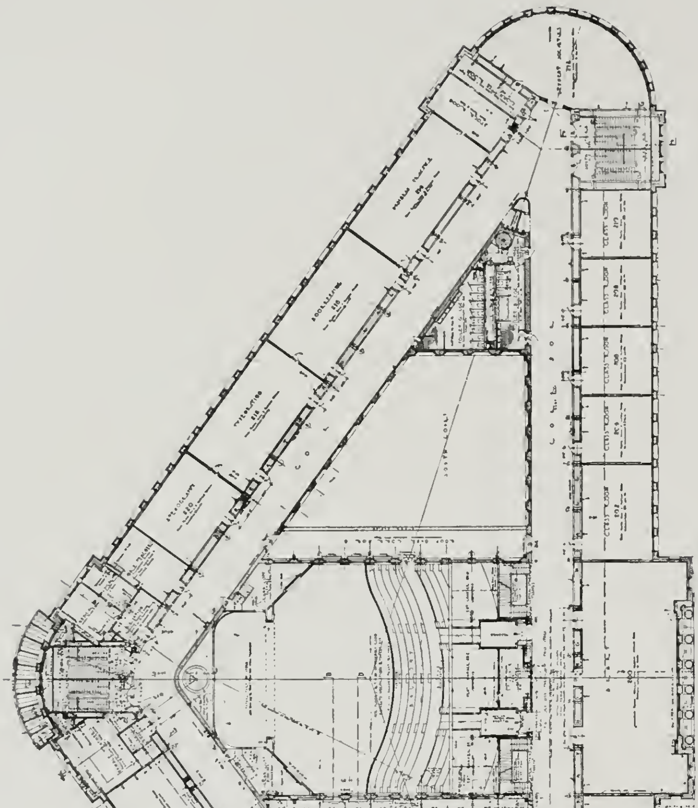


MAIN FLOOR AND PLAT PLAN, UNION HIGH SCHOOL, REDONDO BEACH, CAL.
Allison & Allison, Architects, Los Angeles, Cal.

SCHENLEY HIGH SCHOOL, PITTSBURGH, PA.
Edward Stotz, Architect, Pittsburgh.

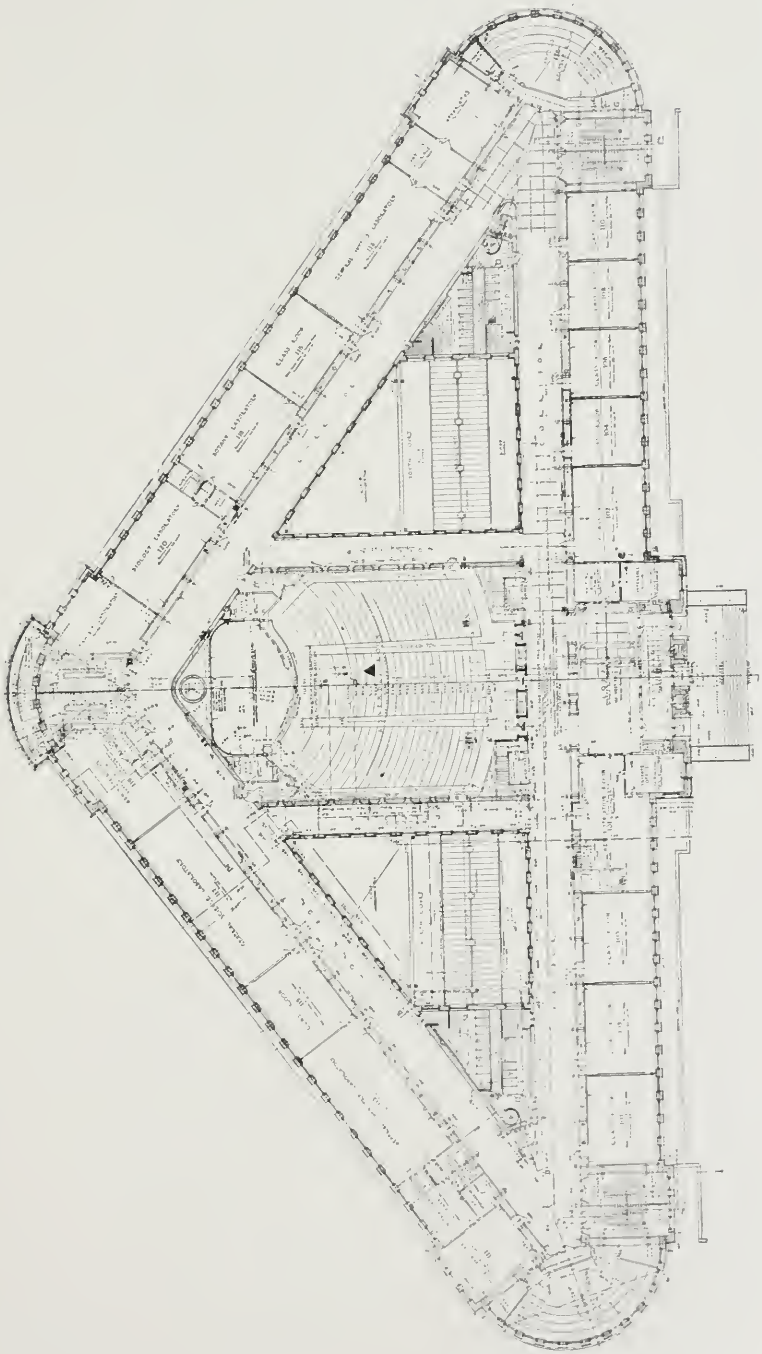


THIRD FLOOR PLAN, SCHENLEY HIGH SCHOOL, PITTSBURGH, PA.
Edward Stotz, Architect, Pittsburgh.



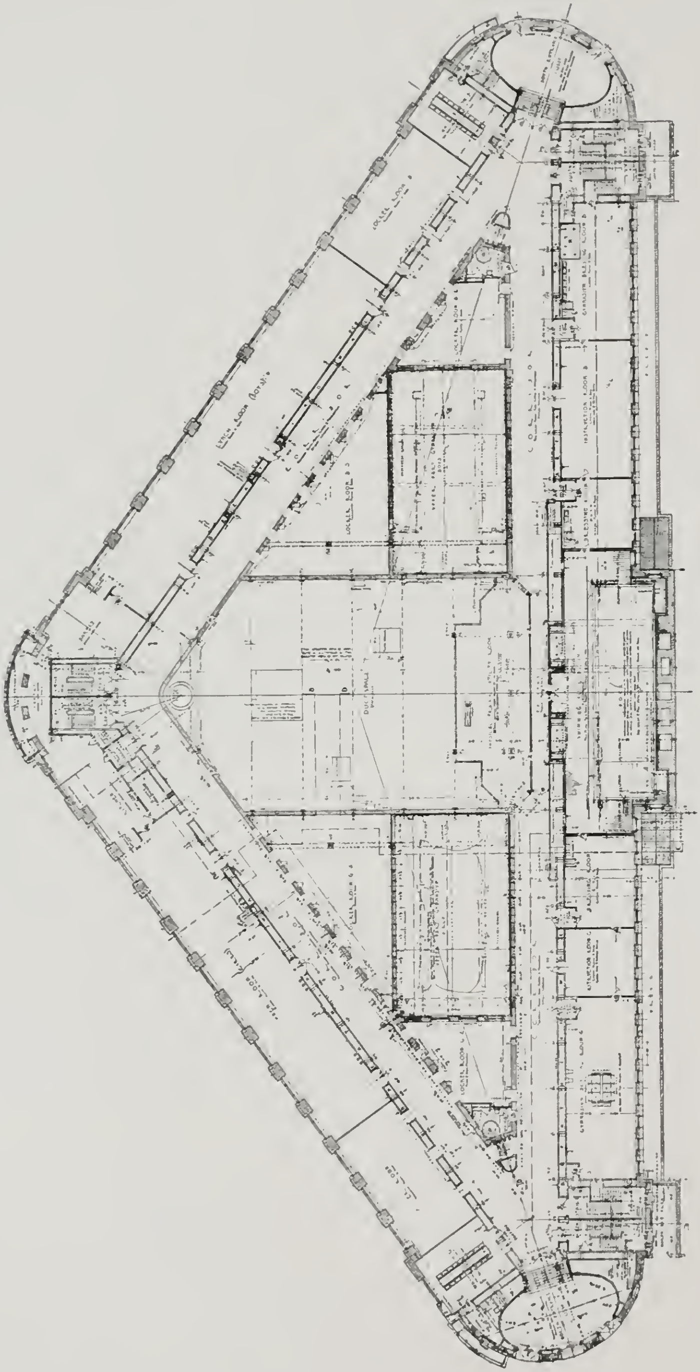
SECOND FLOOR PLAN, SCHENLEY HIGH SCHOOL, PITTSBURGH, PA.

Edward Stotz, Architect, Pittsburgh.



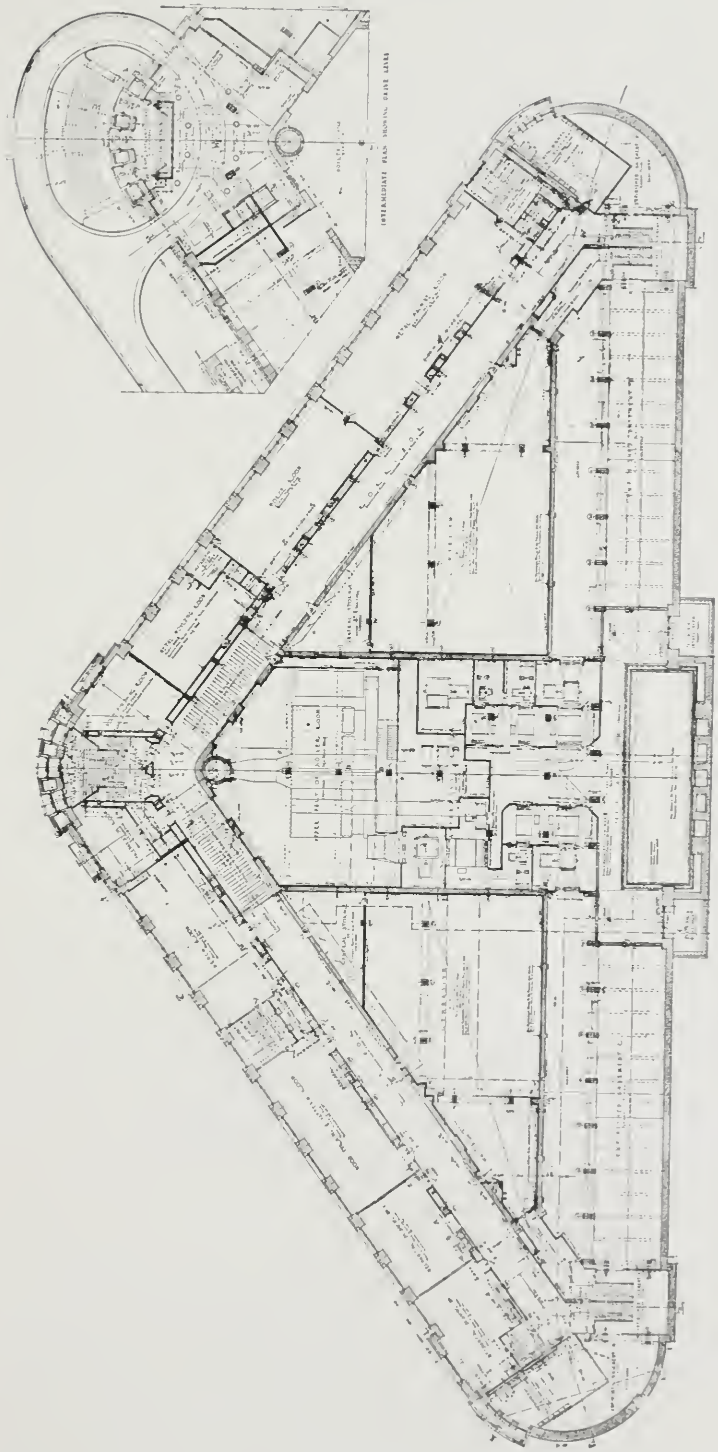
FIRST FLOOR PLAN, SCHENLEY HIGH SCHOOL, PITTSBURGH, PA.

Edward Stotz, Architect, Pittsburgh.



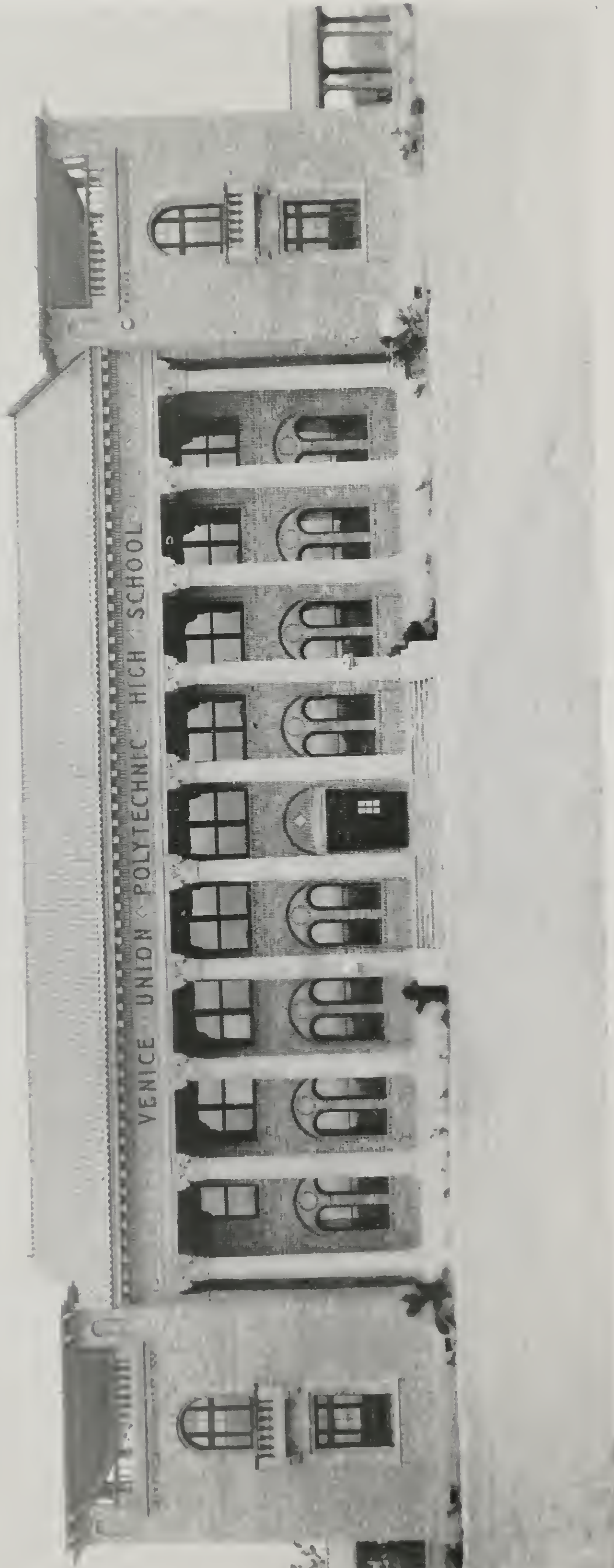
GROUND FLOOR PLAN, SCHENLEY HIGH SCHOOL, PITTSBURGH, PA.

Edward Stotz, Architect, Pittsburgh.



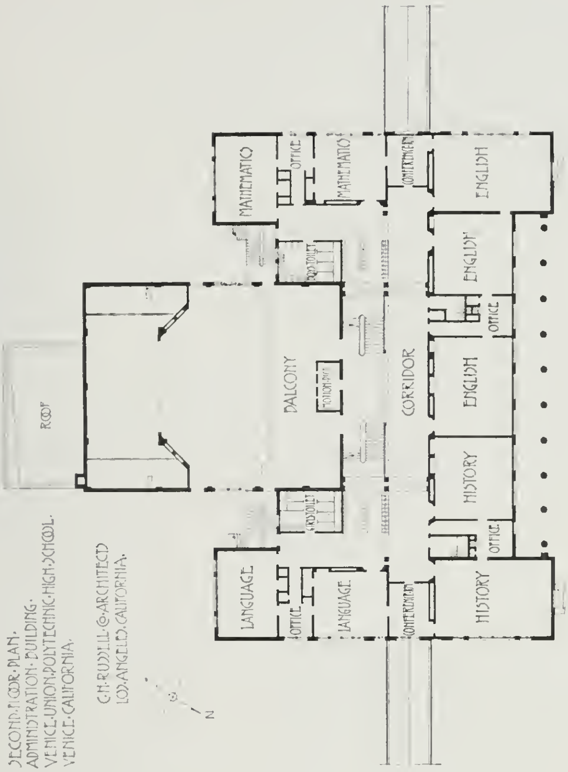
BASEMENT PLAN, SCHENLEY HIGH SCHOOL, PITTSBURGH, PA.

Edward Stotz, Architect, Pittsburgh.



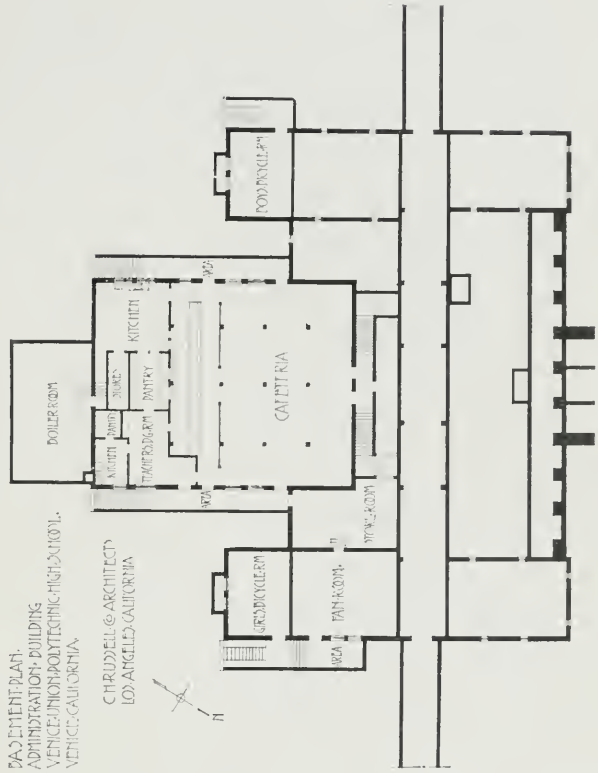
ADMINISTRATION BUILDING. UNION POLYTECHNIC HIGH SCHOOL, VENICE, CAL.

C. H. Russell Co., Architects, Los Angeles, Cal.



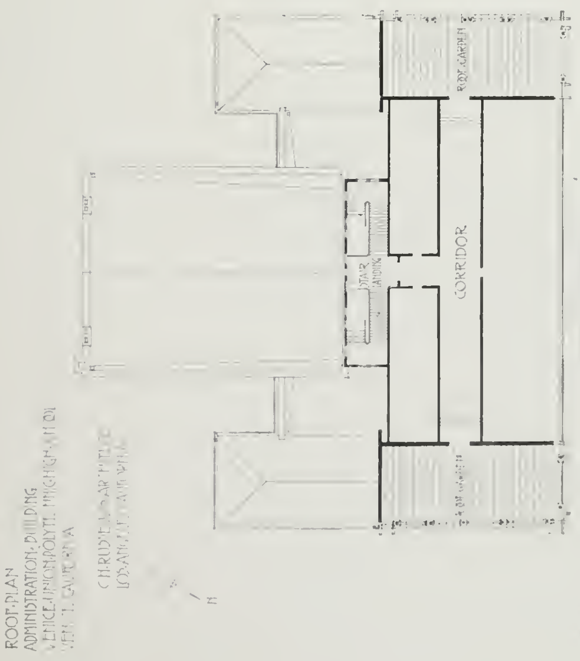
SECOND·FLOOR·PLAN·
ADMINISTRATION·BUILDING·
VENICE·UNION·POLYTECHNIC·HIGH·SCHOOL·
VENICE·CALIFORNIA.

C.H.RUSSELL·&·ARCHITECTS
LOS·ANGELES·CALIFORNIA.



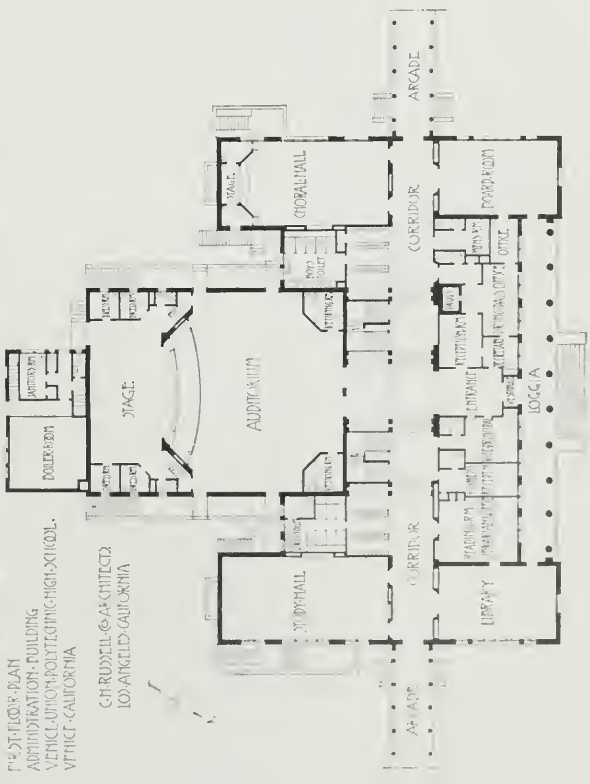
BASEMENT·PLAN·
ADMINISTRATION·BUILDING
VENICE·UNION·POLYTECHNIC·HIGH·SCHOOL·
VENICE·CALIFORNIA·

C.H.RUSSELL·&·ARCHITECTS
LOS·ANGELES·CALIFORNIA



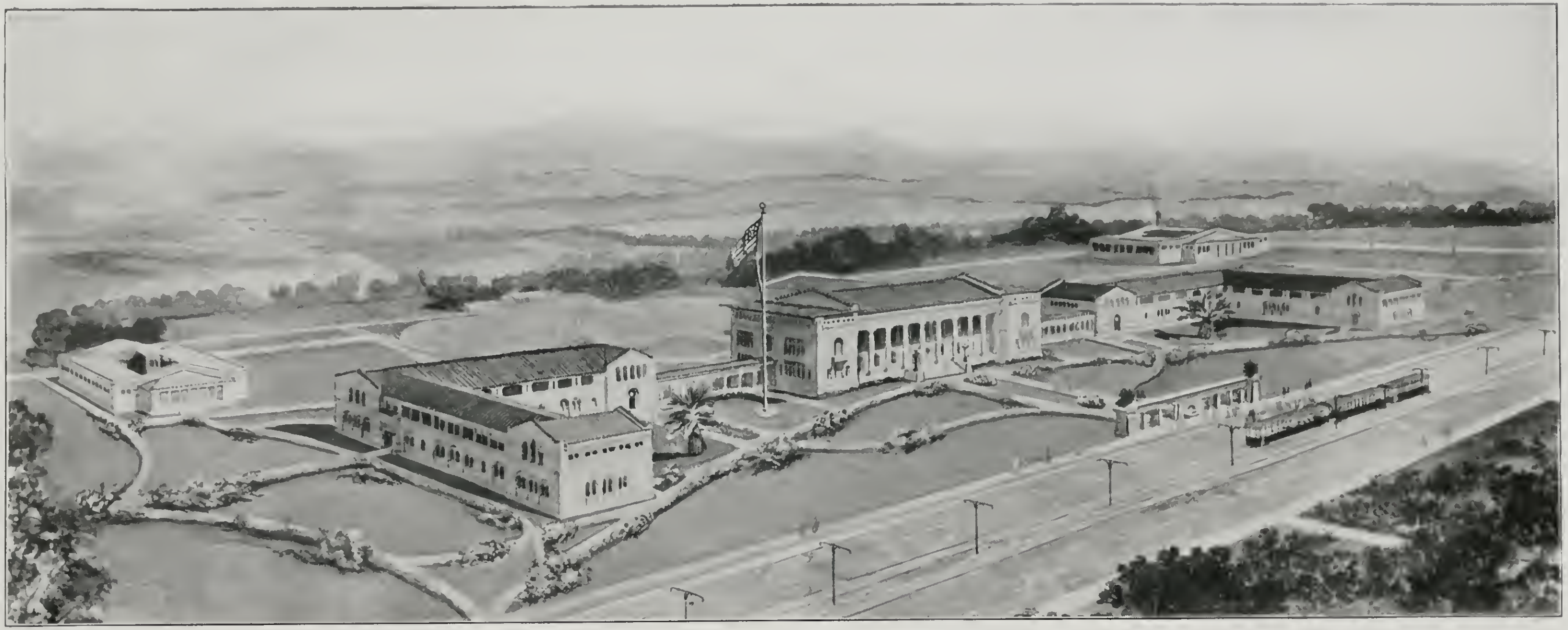
ROOF·PLAN
ADMINISTRATION·BUILDING
VENICE·UNION·POLYTECHNIC·HIGH·SCHOOL
VENICE·CALIFORNIA

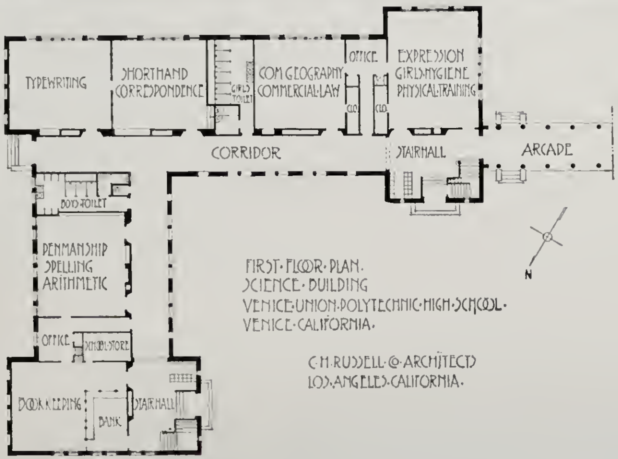
C.H.RUSSELL·&·ARCHITECTS
LOS·ANGELES·CALIFORNIA



FIRST·FLOOR·PLAN
ADMINISTRATION·BUILDING
VENICE·UNION·POLYTECHNIC·HIGH·SCHOOL·
VENICE·CALIFORNIA

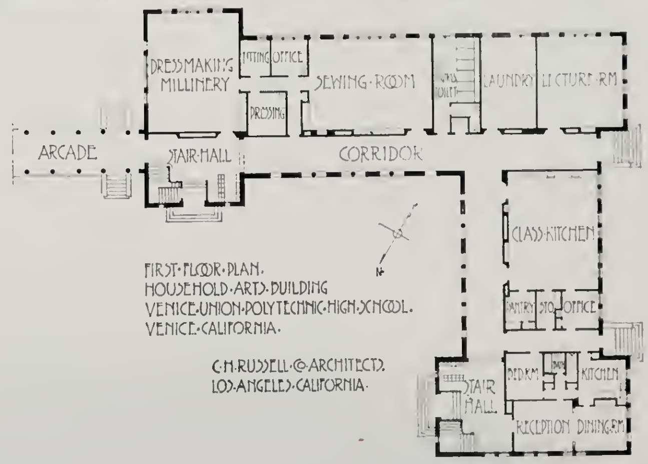
C.H.RUSSELL·&·ARCHITECTS
LOS·ANGELES·CALIFORNIA

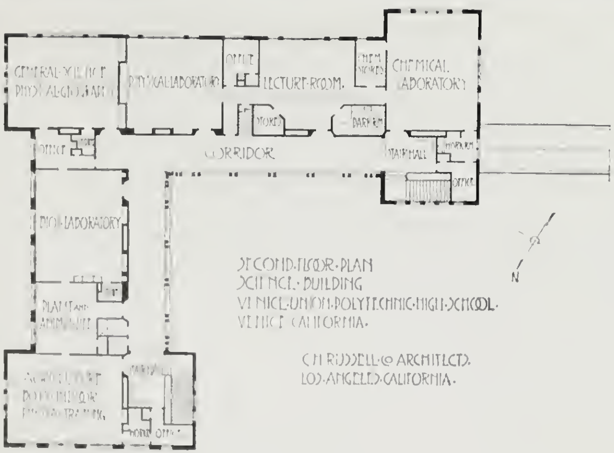




BIRDSEYE VIEW
UNION POLYTECHNIC HIGH
SCHOOL, VENICE, CAL.

C. H. Russell Co., Architects,
Los Angeles, Cal.

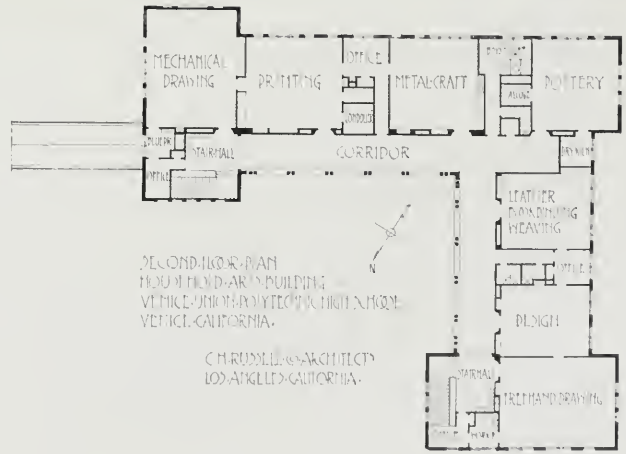




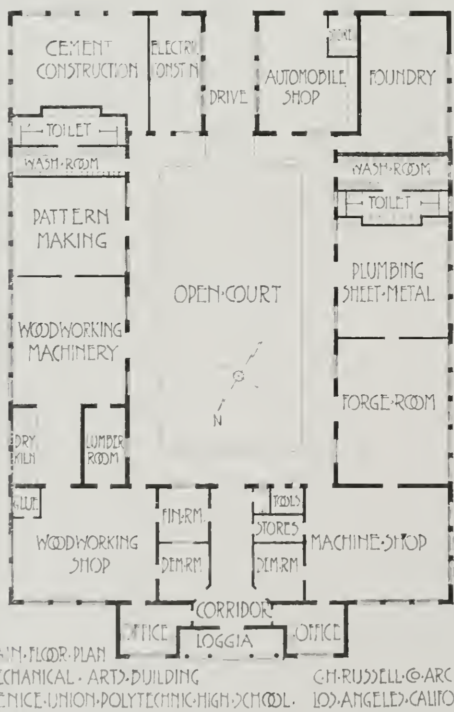
SCIENCE BUILDING
UNION POLYTECHNIC HIGH
SCHOOL, VENICE, CAL.

(Exterior Household Arts Building is reversed duplicate of above building.)

C. H. Russell Co., Architects,
Los Angeles, Cal.



MECHANICAL ARTS BUILDING, UNION POLYTECHNIC HIGH SCHOOL, VENICE, CAL.

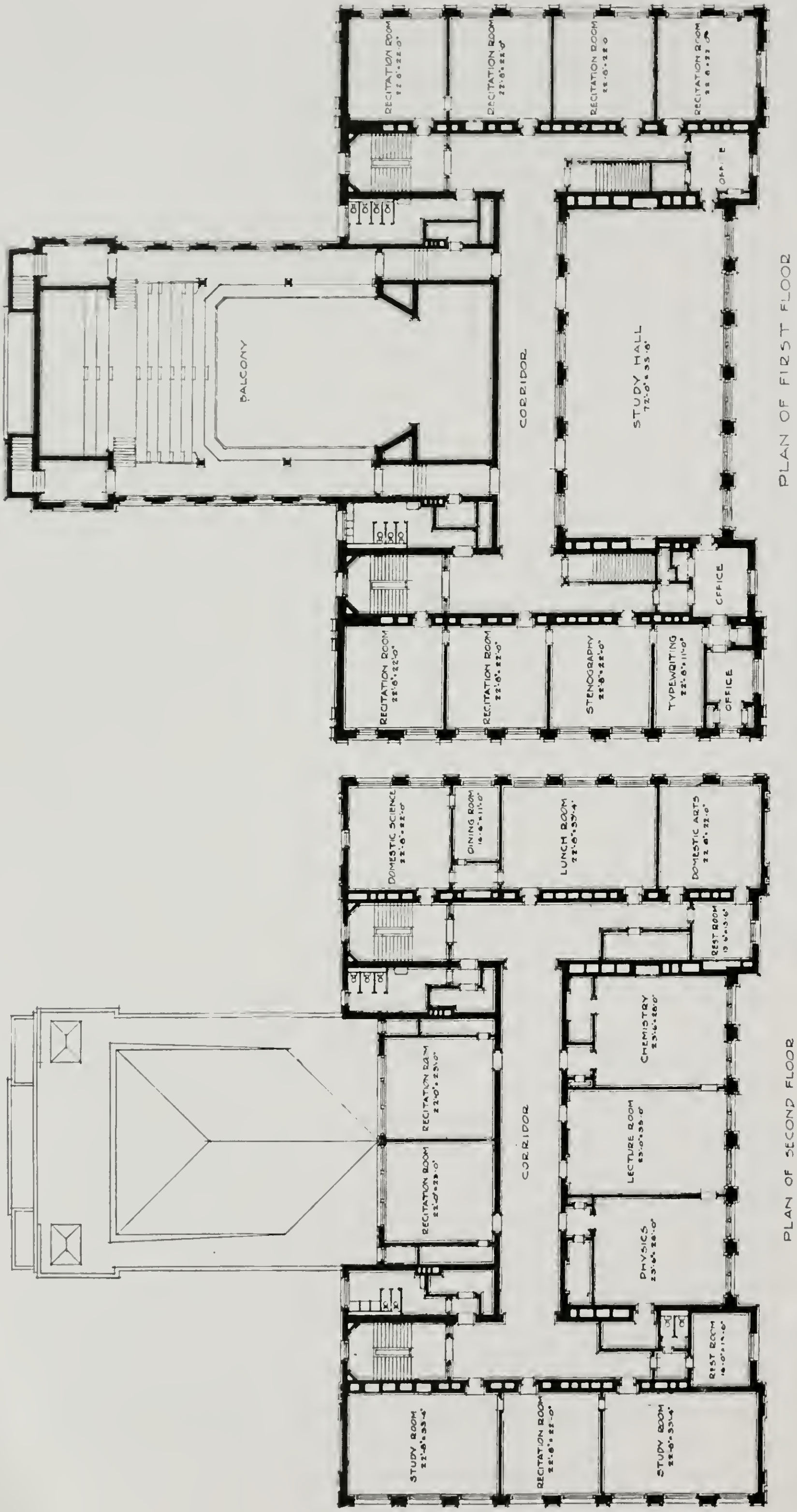


MAIN-FLOOR-PLAN
MECHANICAL-ARTS-BUILDING
VENICE-UNION-POLYTECHNIC-HIGH-SCHOOL
VENICE-CALIFORNIA

C.H. RUSSELL-CO.-ARCHITECTS
LOS-ANGELES-CALIFORNIA

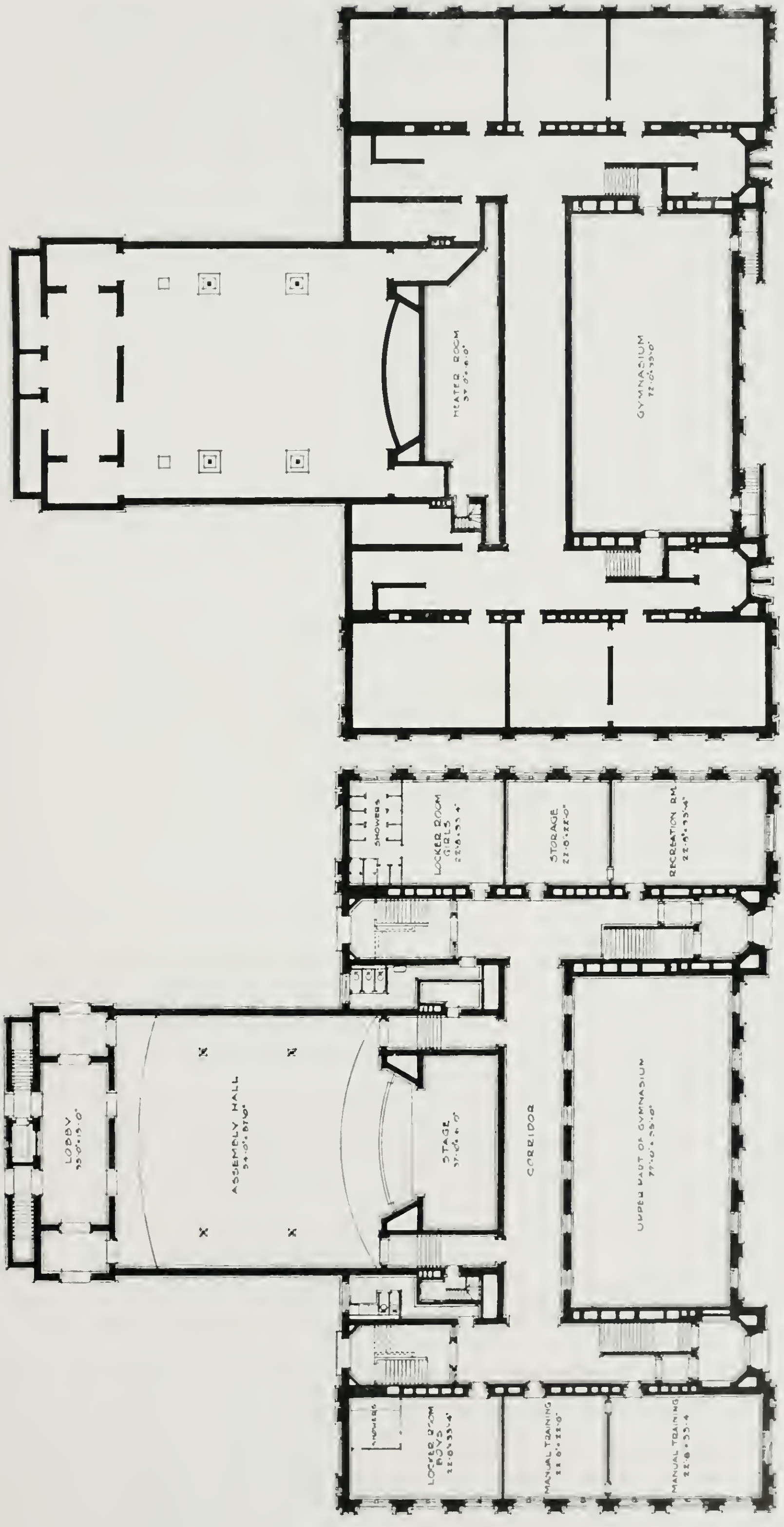
HIGH SCHOOL, SIDNEY, O.

Frank L. Packard, Architect, Columbus, O.



FLOOR PLANS, HIGH SCHOOL, SIDNEY, O.

Frank L. Packard, Architect, Columbus, O.

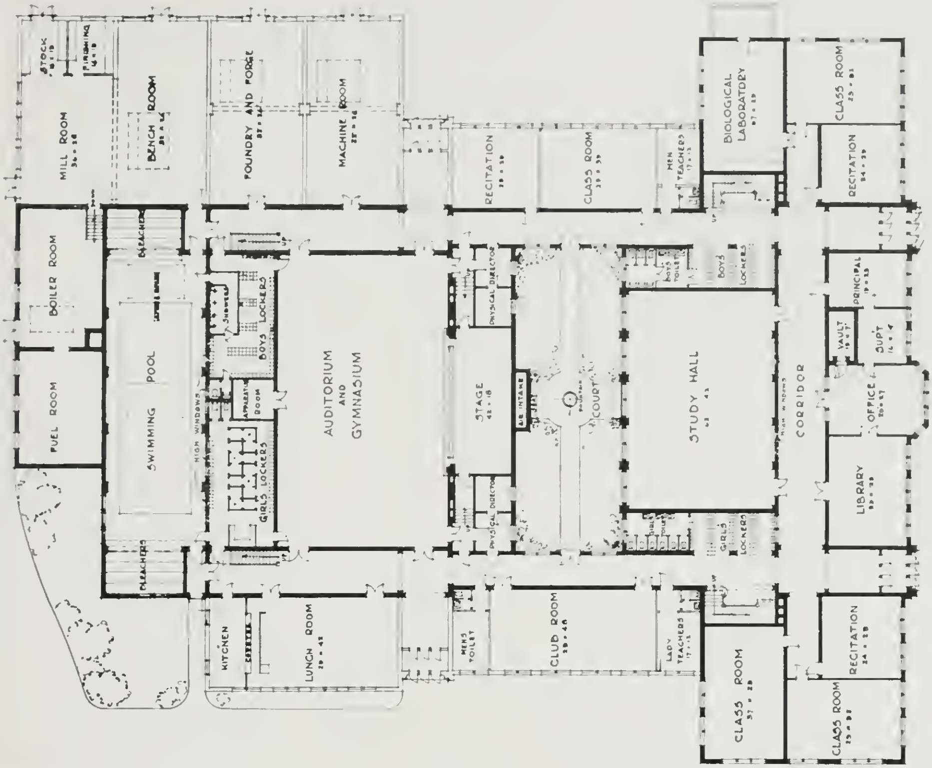


FLOOR PLANS, HIGH SCHOOL, SIDNEY, O.

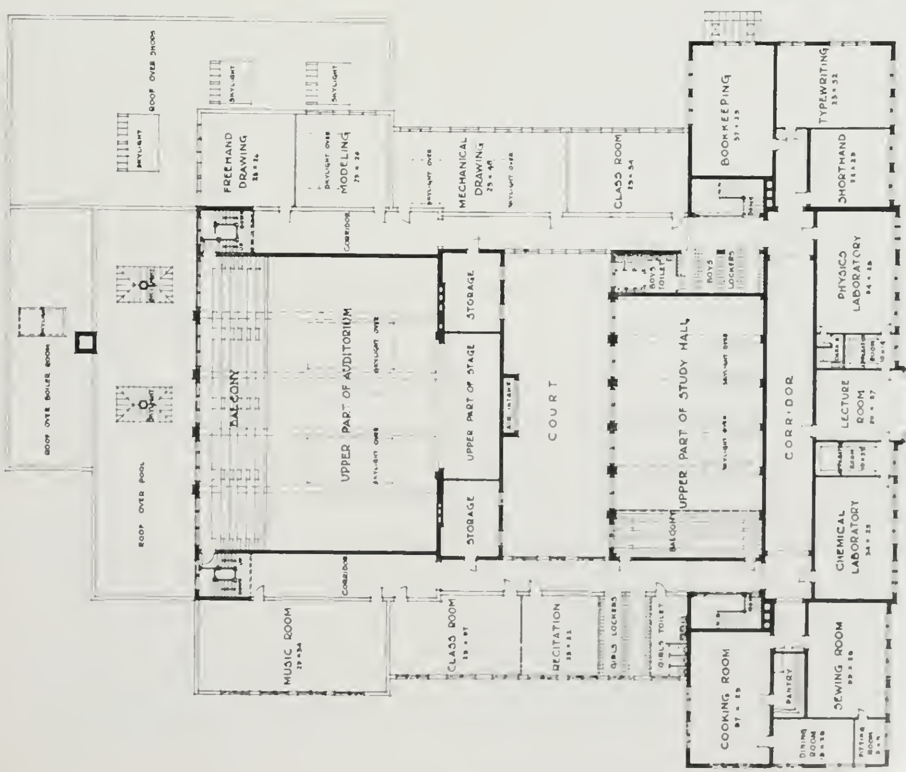
Frank L. Packard, Architect, Columbus, O.

RIVERSIDE-BROOKFIELD HIGH SCHOOL, RIVERSIDE, ILL.

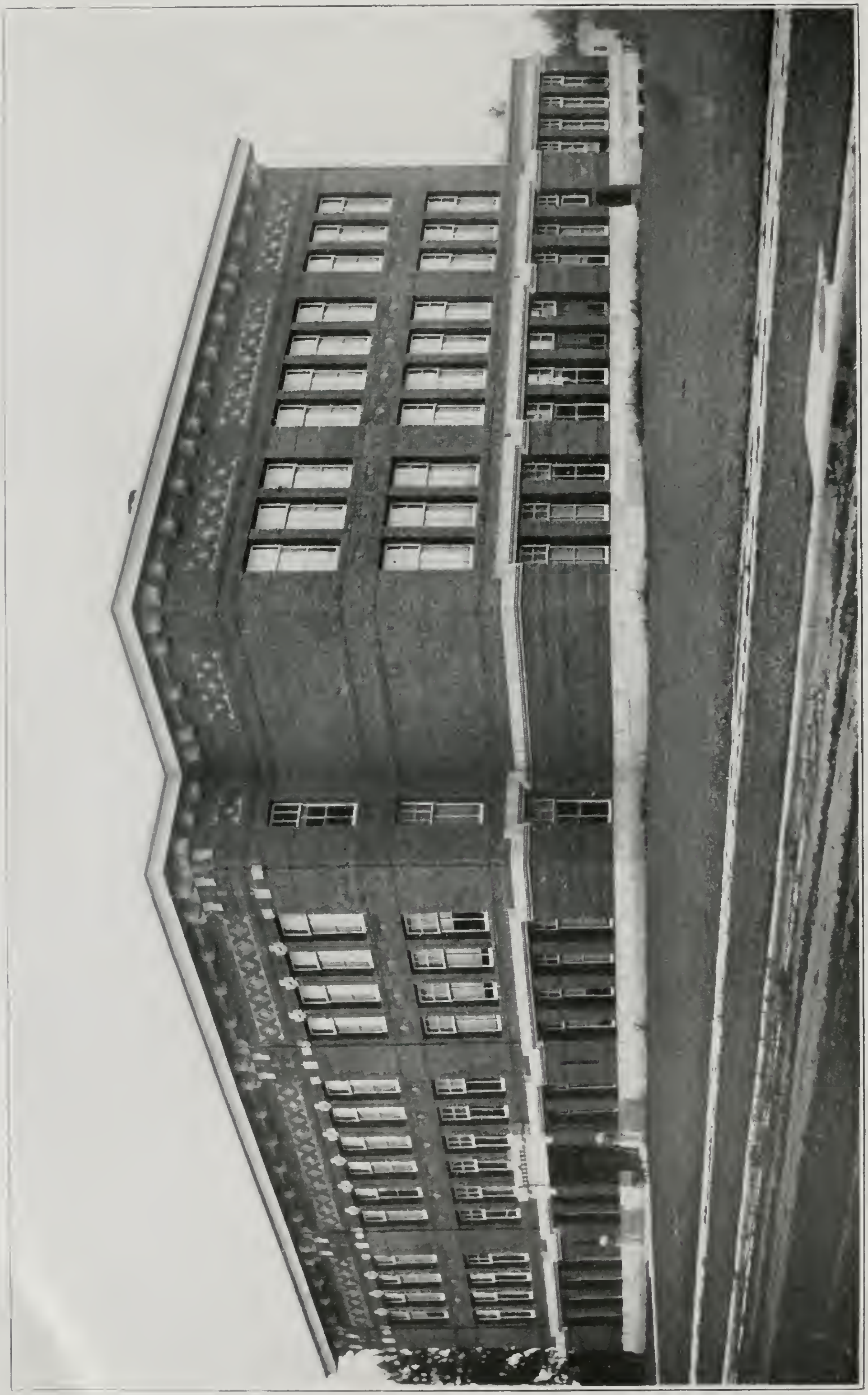
J. C. Llewellyn, Architect, Chicago, Ill.



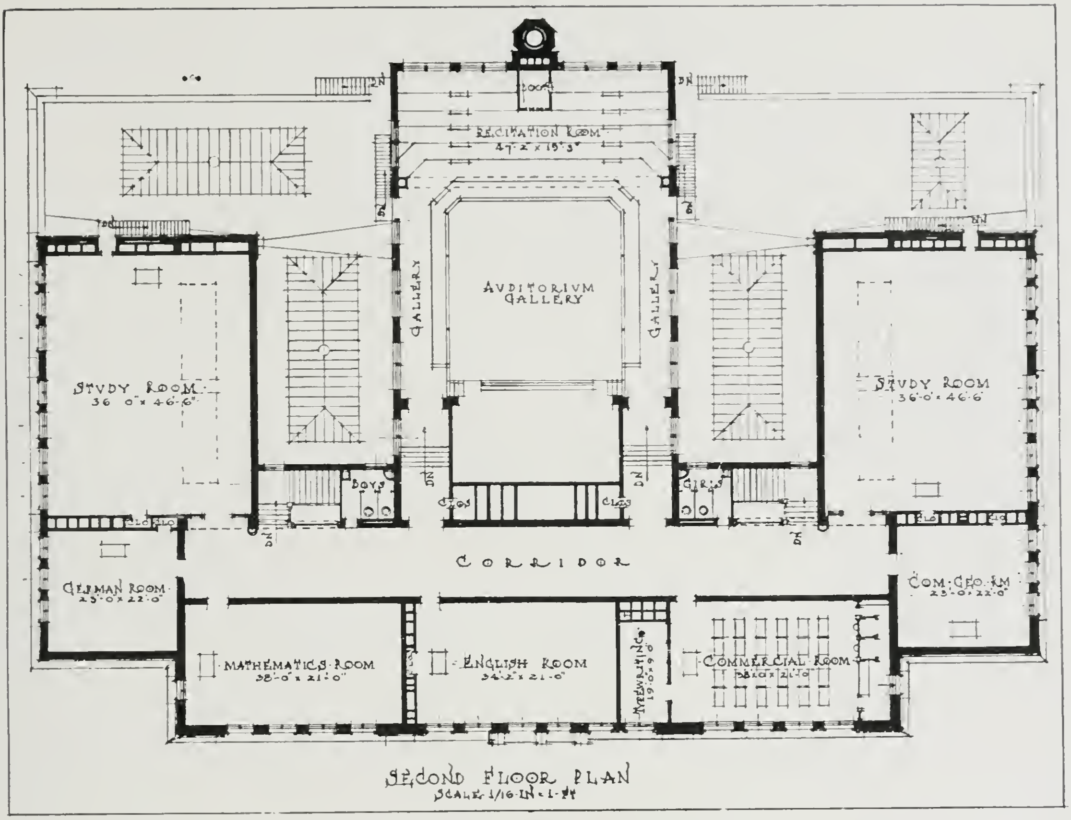
FIRST FLOOR PLAN.
RIVERSIDE-BROOKFIELD HIGH SCHOOL, RIVERSIDE, ILL.

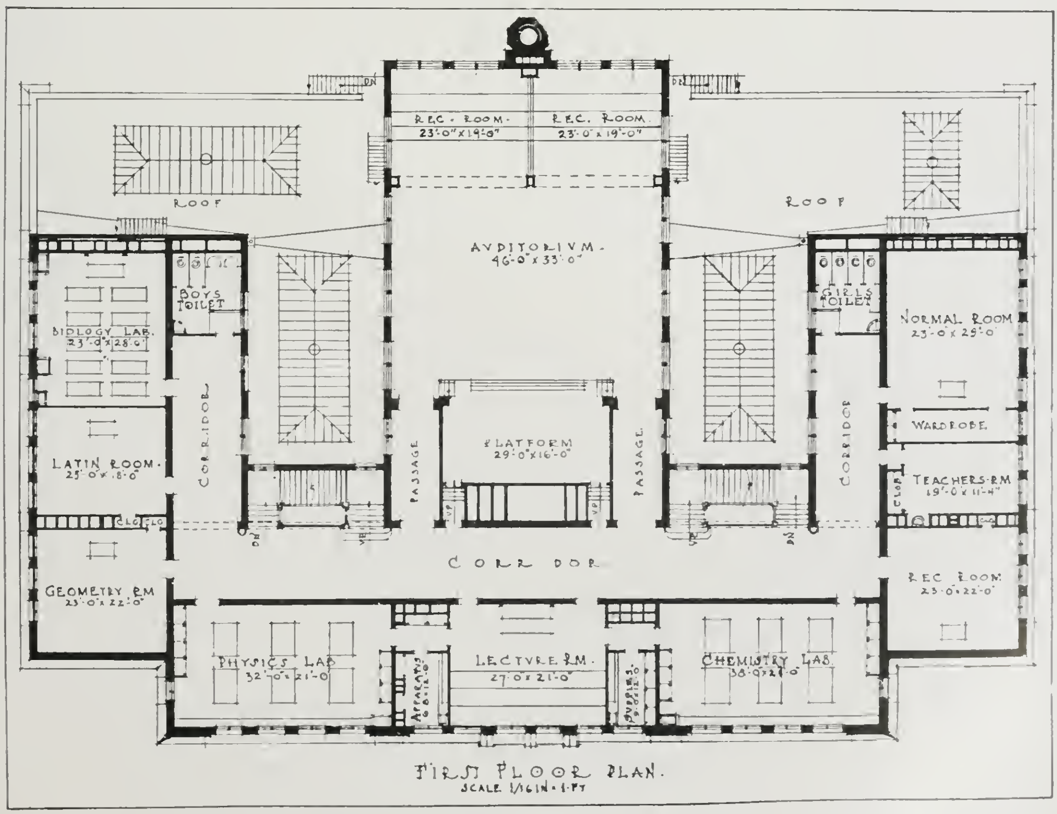


SECOND FLOOR PLAN.
RIVERSIDE-BROOKFIELD HIGH SCHOOL, RIVERSIDE, ILL.

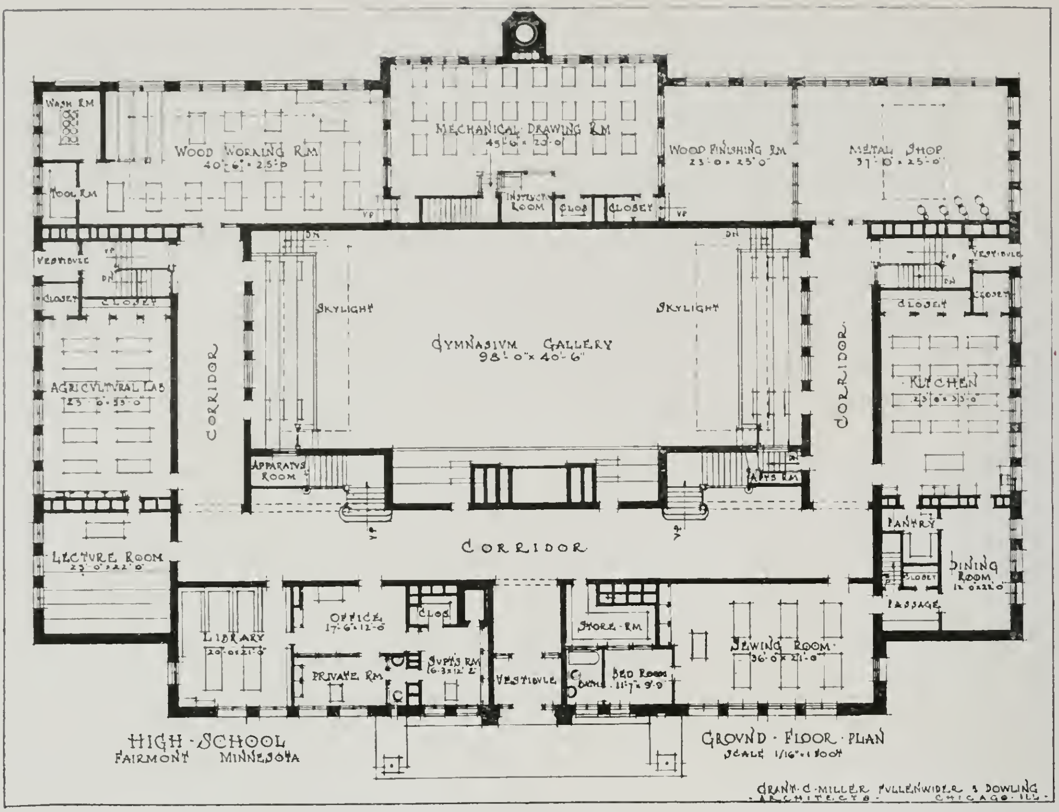


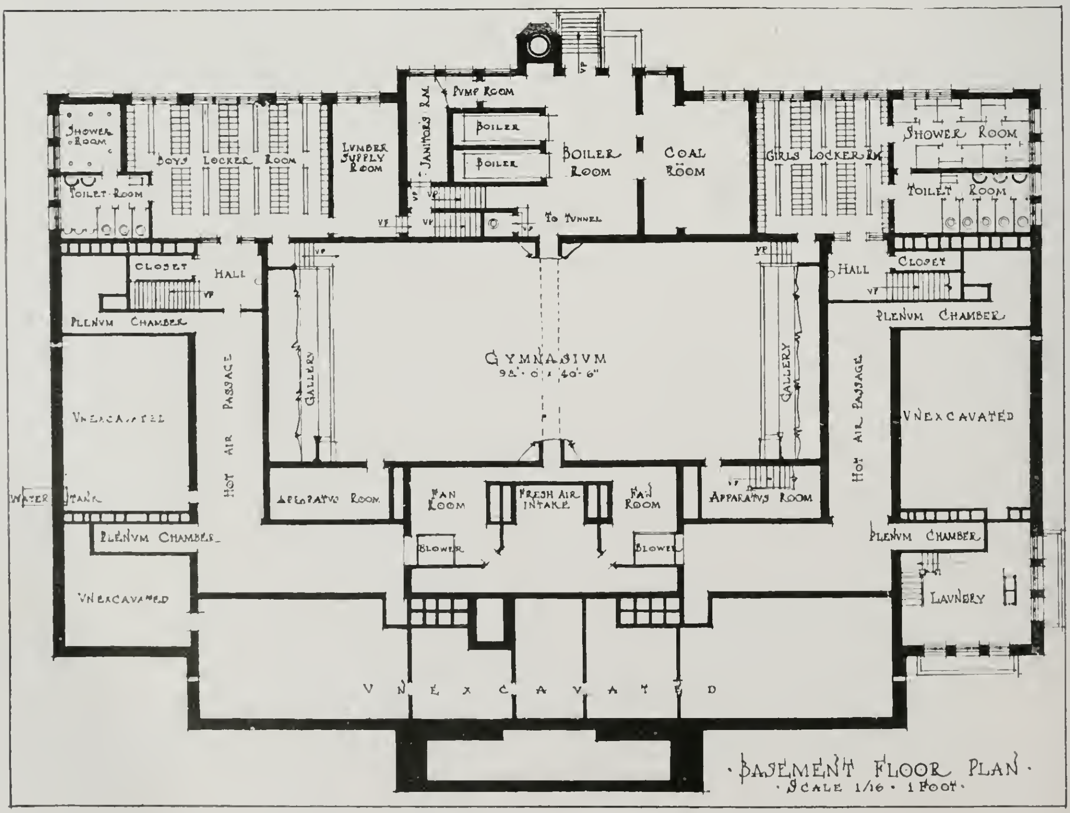
HIGH SCHOOL, FAIRMONT, MINN.
Miller, Fullenwider & Dowling, Architects, Chicago, Ill.



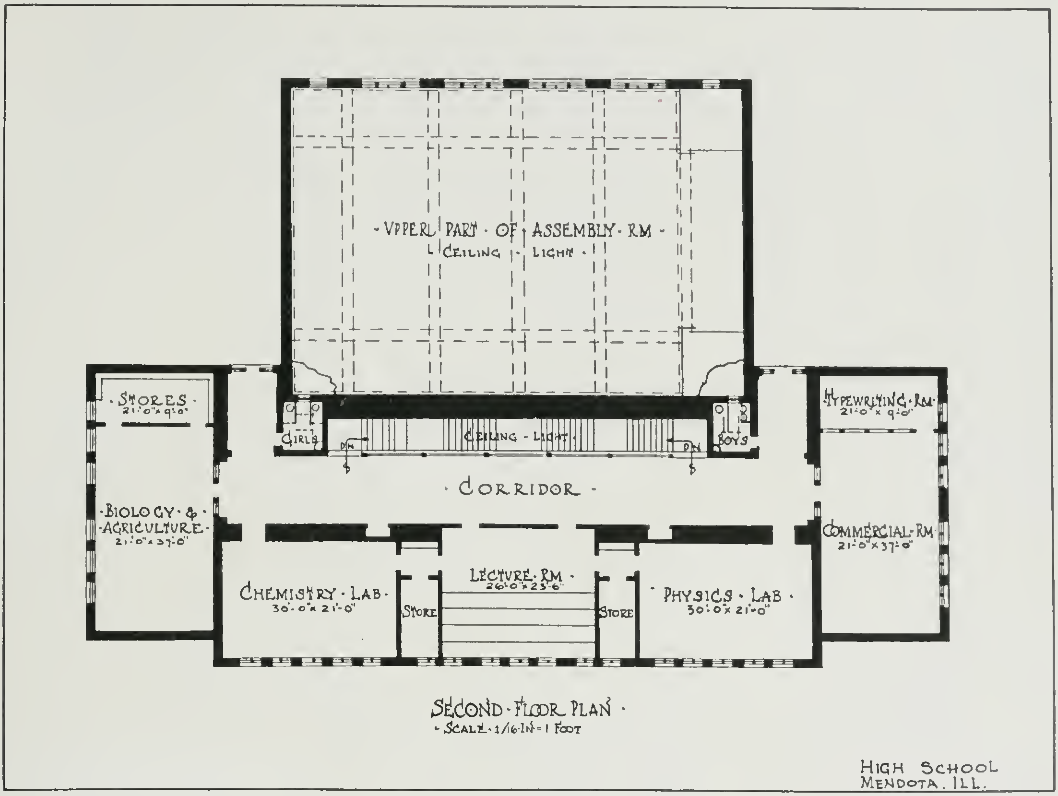


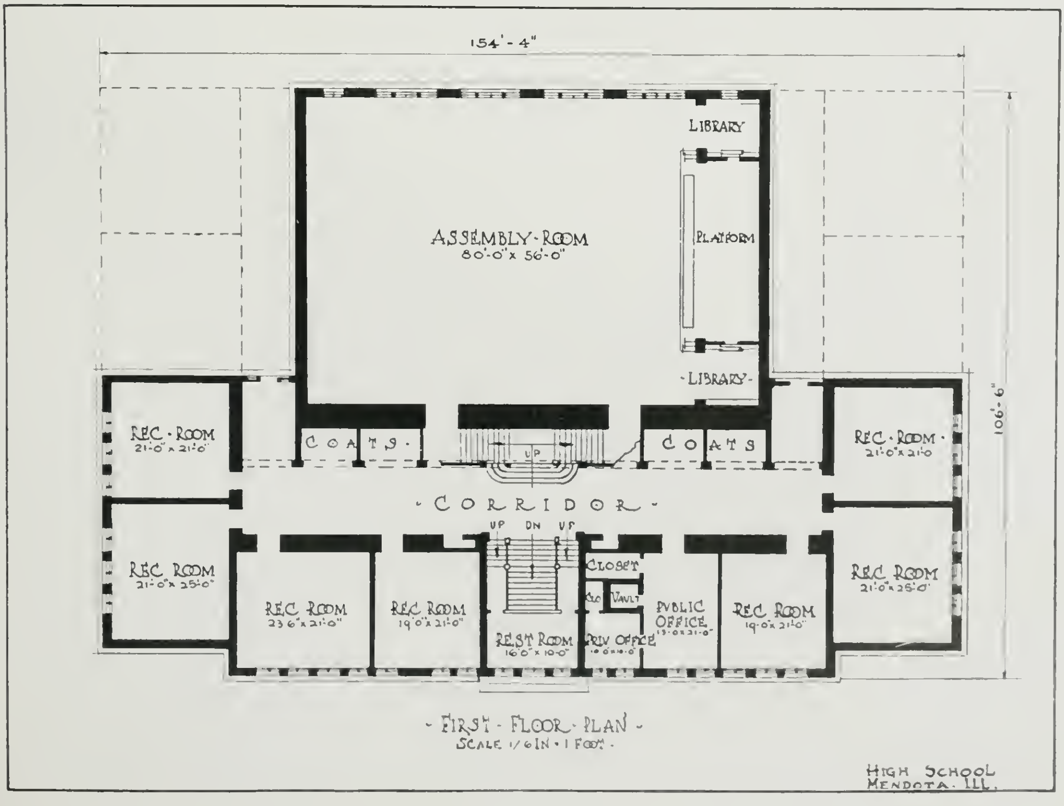
FLOOR PLANS, HIGH SCHOOL, FAIRMONT, MINN.
Miller, Fullenwider & Dowling, Architects, Chicago, Ill.

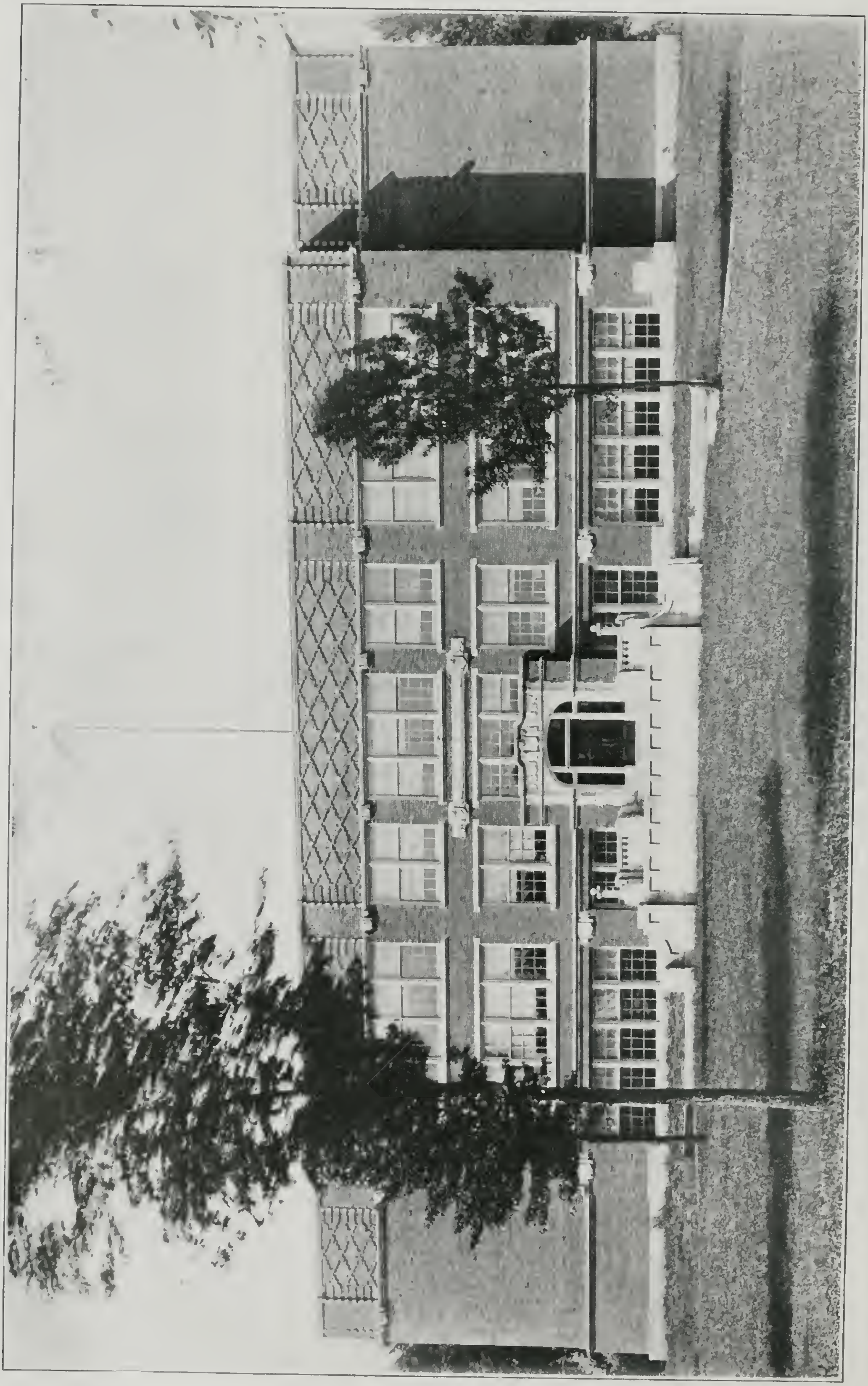




FLOOR PLANS, HIGH SCHOOL, FAIRMONT, MINN.

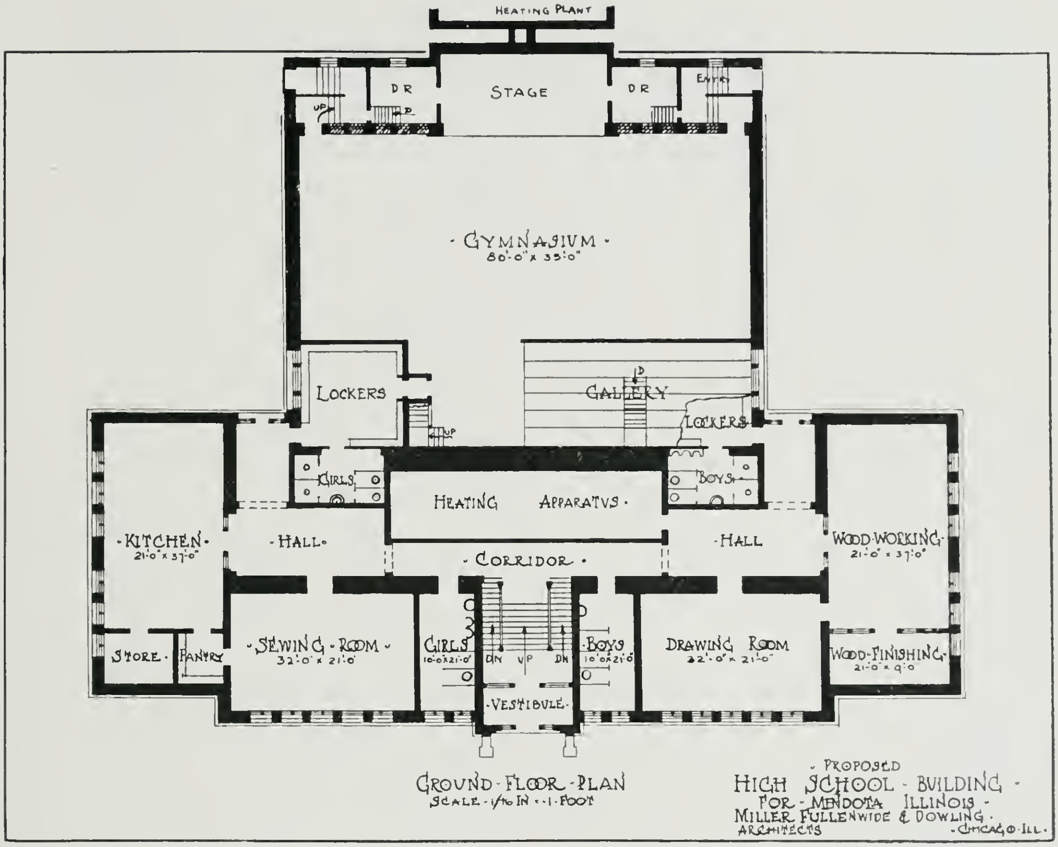

UPPER PART OF ASSEMBLY RM
CEILING LIGHT
STORES
21'-0" x 9'-0"
GIRLS
DN
CEILING - LIGHT
DN
BOYS
TYPEWRITING RM
21'-0" x 9'-0"
CORRIDOR
BIOLOGY & AGRICULTURE
21'-0" x 37'-0"
COMMERCIAL RM
21'-0" x 37'-0"
LECTURE RM
26'-0" x 23'-6"
CHEMISTRY LAB
30'-0" x 21'-0"
STORE
STORE
PHYSICS LAB
30'-0" x 21'-0"
SECOND FLOOR PLAN
SCALE 1/16 IN = 1 FOOT
HIGH SCHOOL
MENDOTA, ILL.

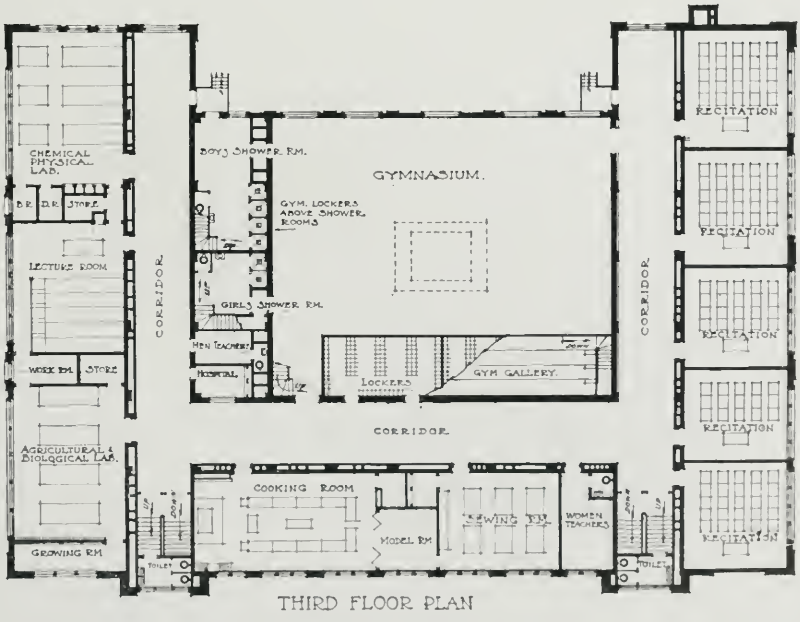

154'-4"
106'-6"
LIBRARY
ASSEMBLY ROOM
80'-0" x 56'-0"
PLATFORM
LIBRARY
REC ROOM
21'-0" x 21'-0"
COATS
UP
COATS
REC ROOM
21'-0" x 21'-0"
CORRIDOR
UP DN UP
REC ROOM
21'-0" x 25'-0"
CLOSET
VAULT
REC ROOM
23'6" x 21'-0"
REC ROOM
19'-0" x 21'-0"
PUBLIC OFFICE
REC ROOM
19'-0" x 21'-0"
REC ROOM
21'-0" x 25'-0"
REST ROOM
16'-0" x 10'-0"
PRIV OFFICE
FIRST FLOOR PLAN
SCALE 1/16 IN = 1 FOOT
HIGH SCHOOL
MENDOTA, ILL.



HIGH SCHOOL, MENDOTA, ILL.

Miller, Fullenwider & Dowling, Architects, Chicago, Ill.

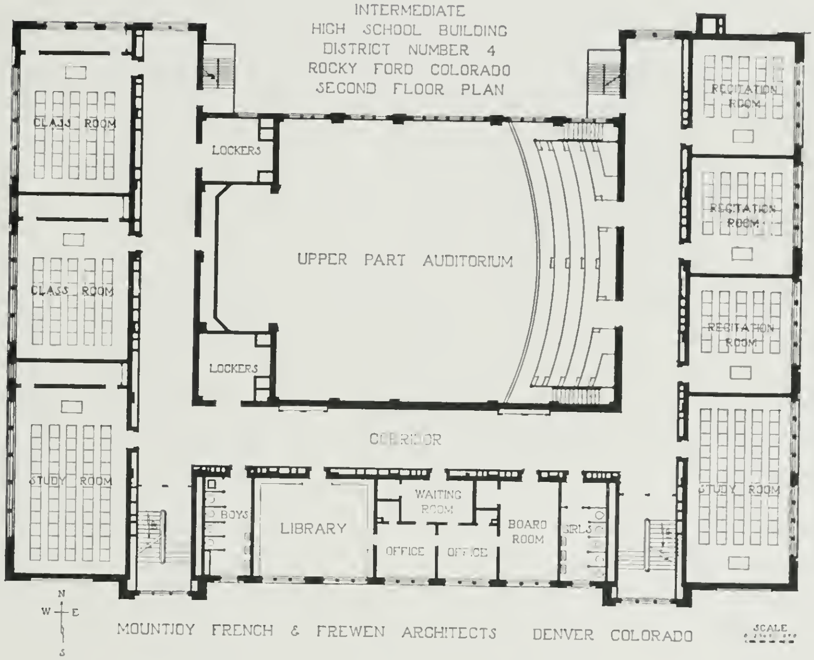


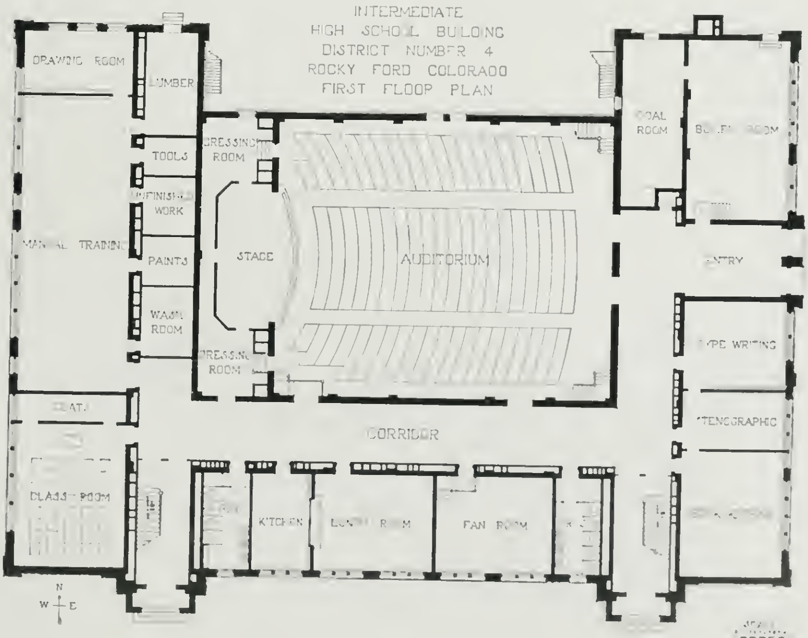


THIRD FLOOR PLAN, INTERMEDIATE HIGH SCHOOL, ROCKY FORD, COLO.

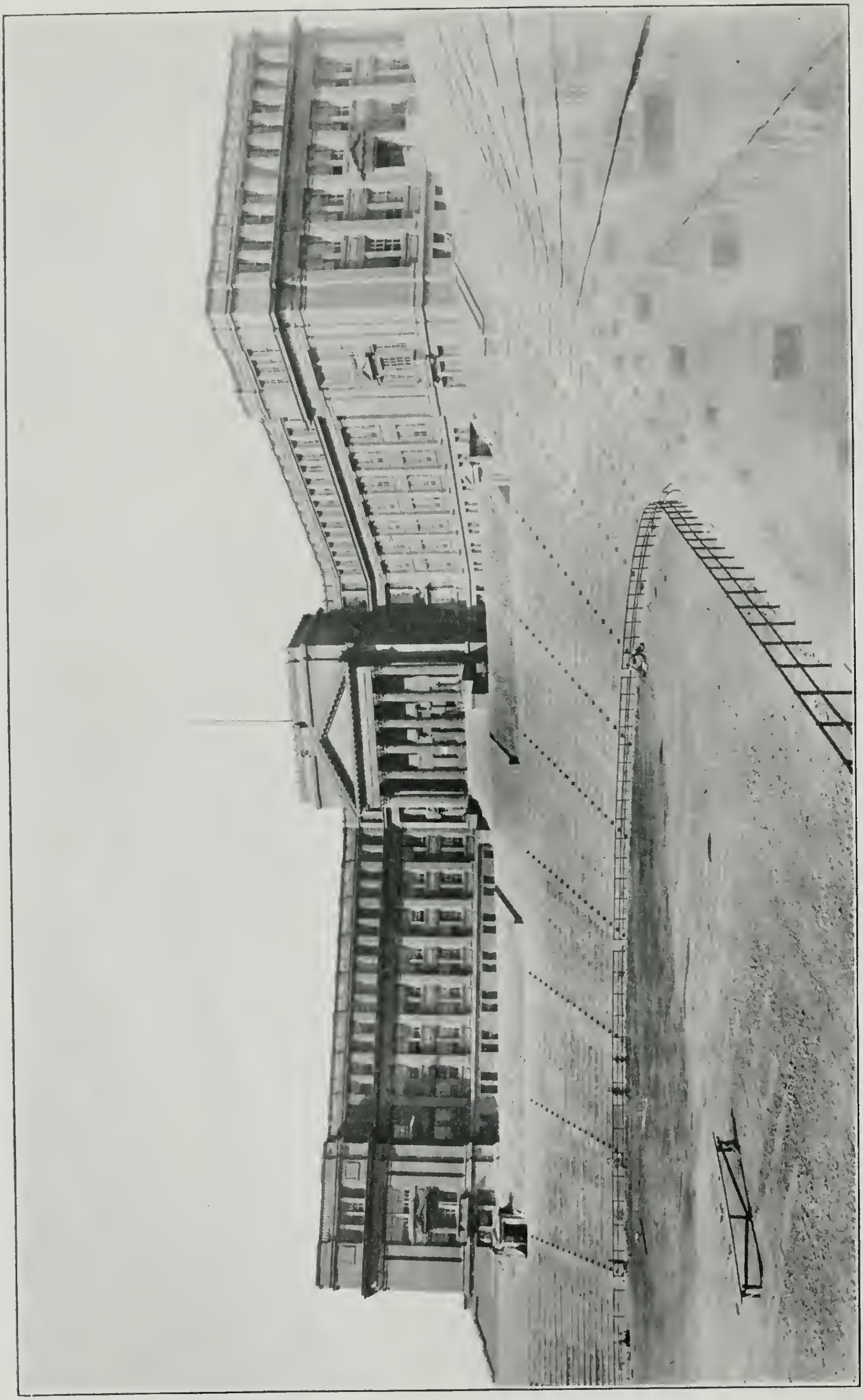
ROCKY FORD INTERMEDIATE HIGH SCHOOL, ROCKY FORD, COLO.

Mountjoy, French & Frewen, Architects, Denver, Colo.



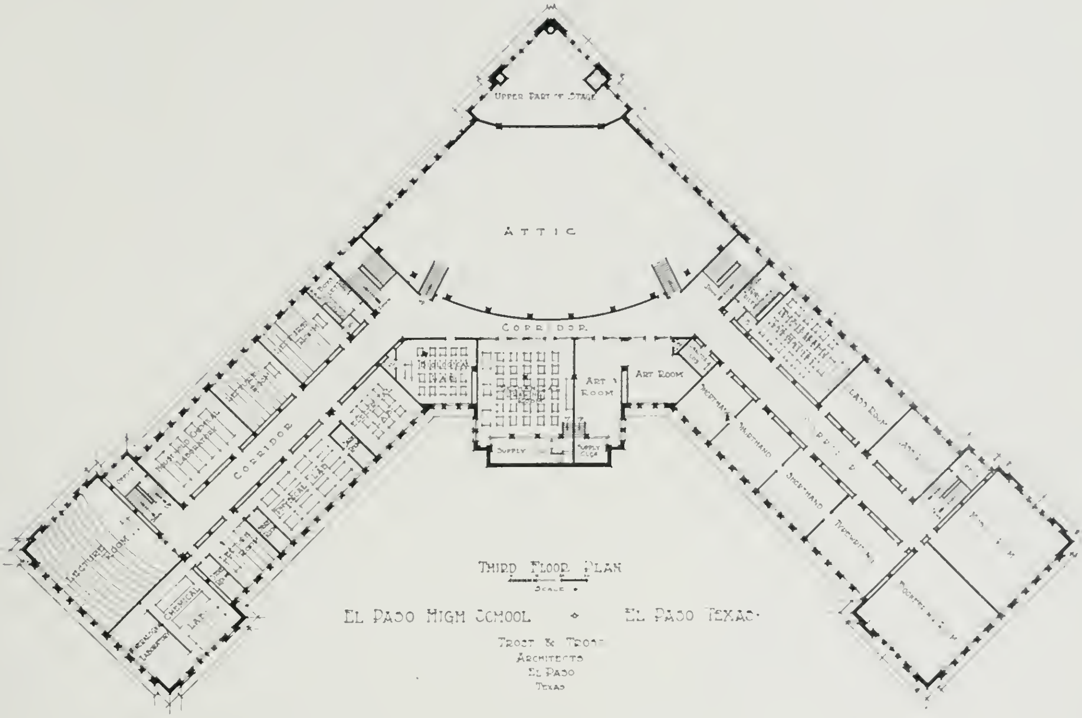


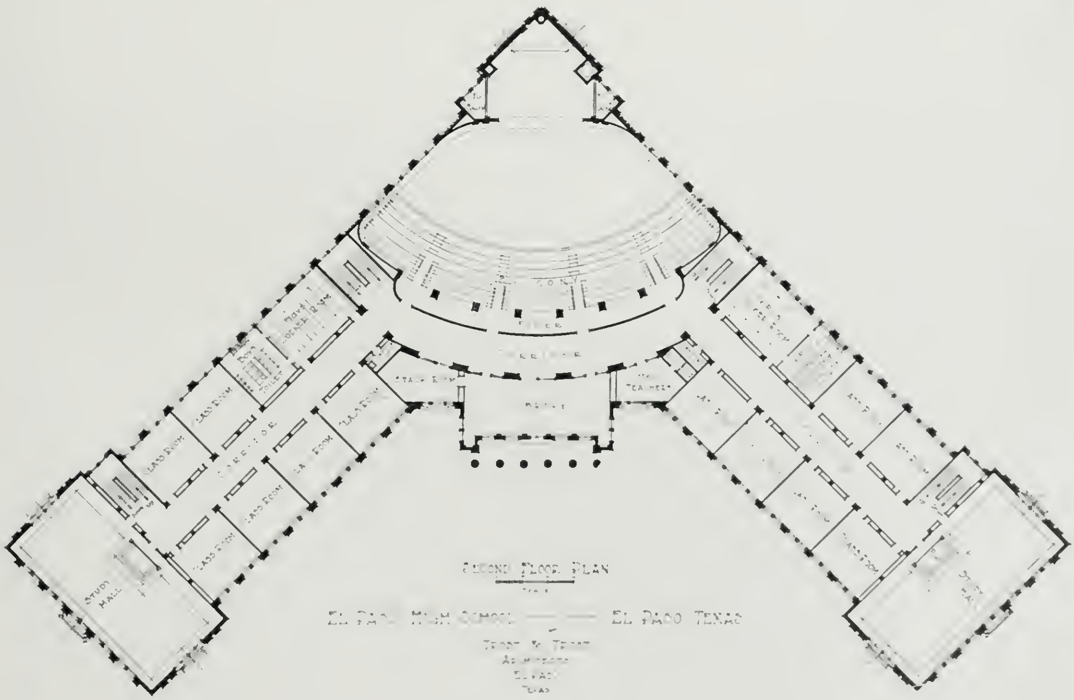
FLOOR PLANS OF THE INTERMEDIATE HIGH SCHOOL, ROCKY FORD, COLO.

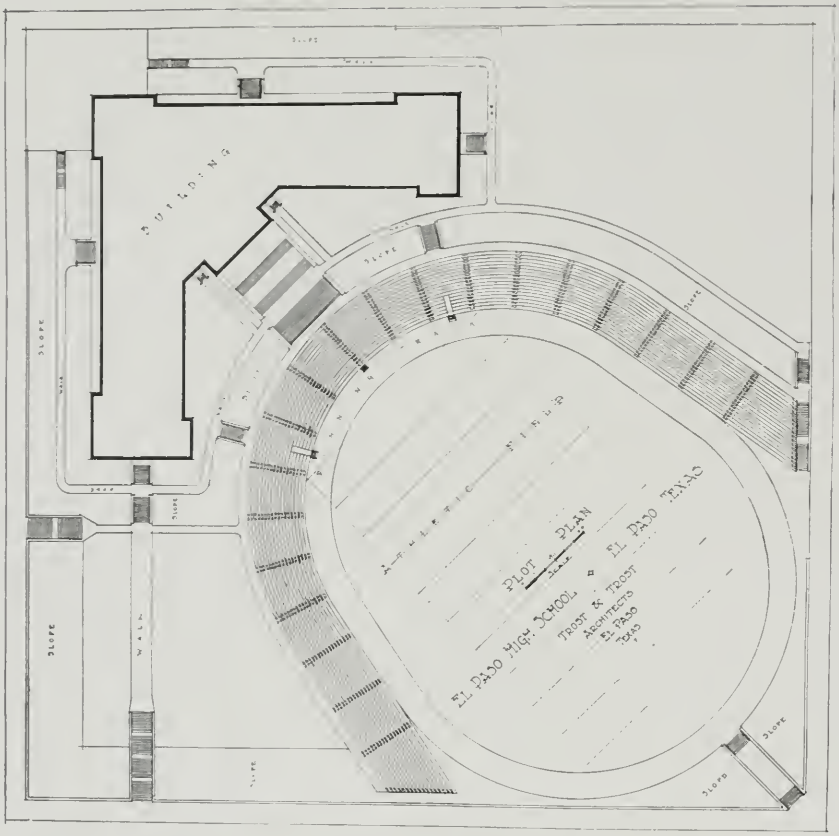


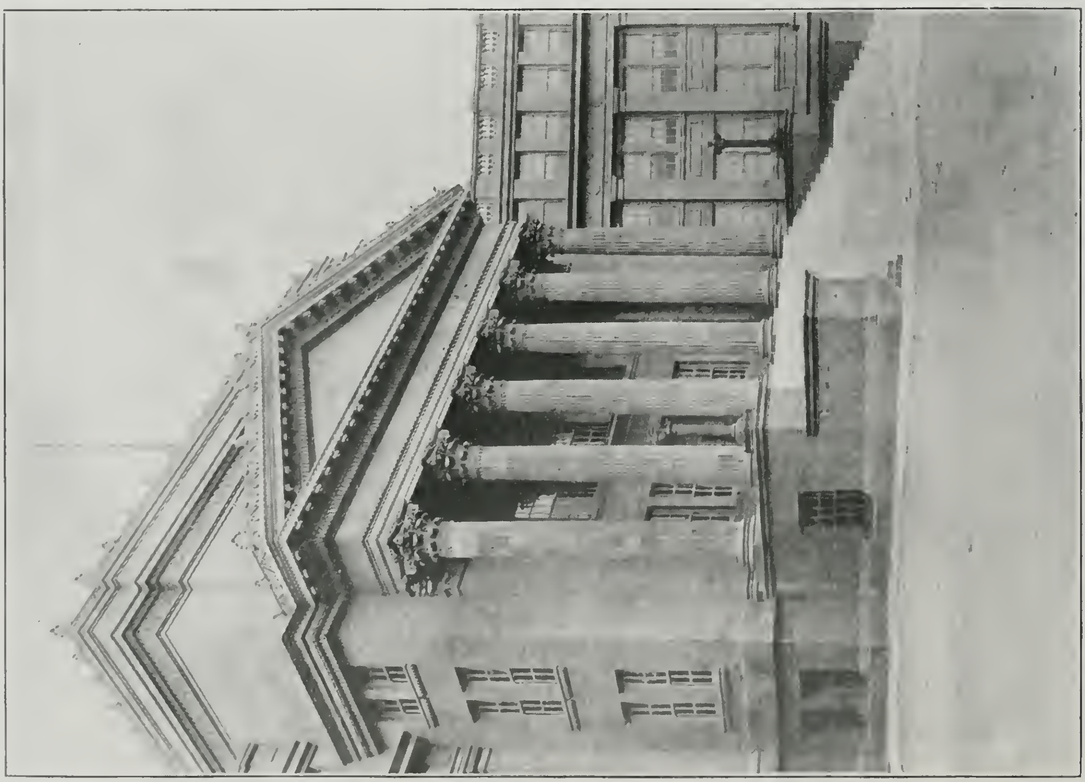
HIGH SCHOOL, EL PASO, TEX.

Trost & Trost, Architects, El Paso.


UPPER PART OF STAGE
ATTIC
CORRIDOR
ART ROOM
ART ROOM
CORRIDOR
LECTURE ROOM
CHEMICAL LAB
SUPPLY
THIRD FLOOR PLAN
SCALE
EL PASO HIGH SCHOOL
EL PASO TEXAS
TROST & TROST
ARCHITECTS
EL PASO
TEXAS

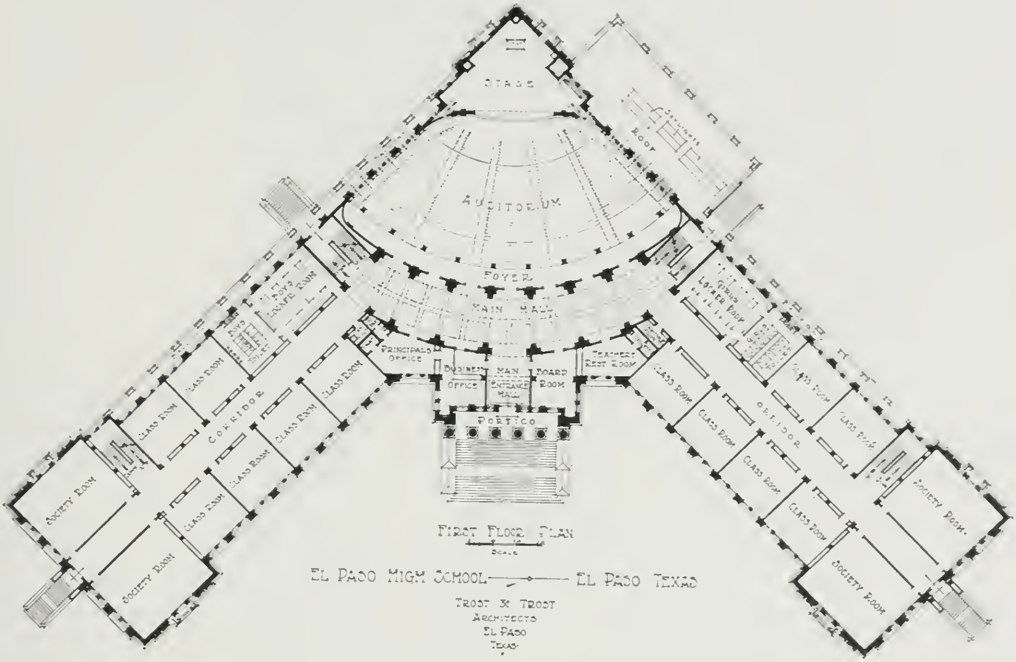

CORRIDOR
STUDY HALL
SECOND FLOOR PLAN
EL PASO TEXAS





DETAIL OF ENTRANCE AND PLAT PLAN, HIGH SCHOOL, EL PASO, TEX.

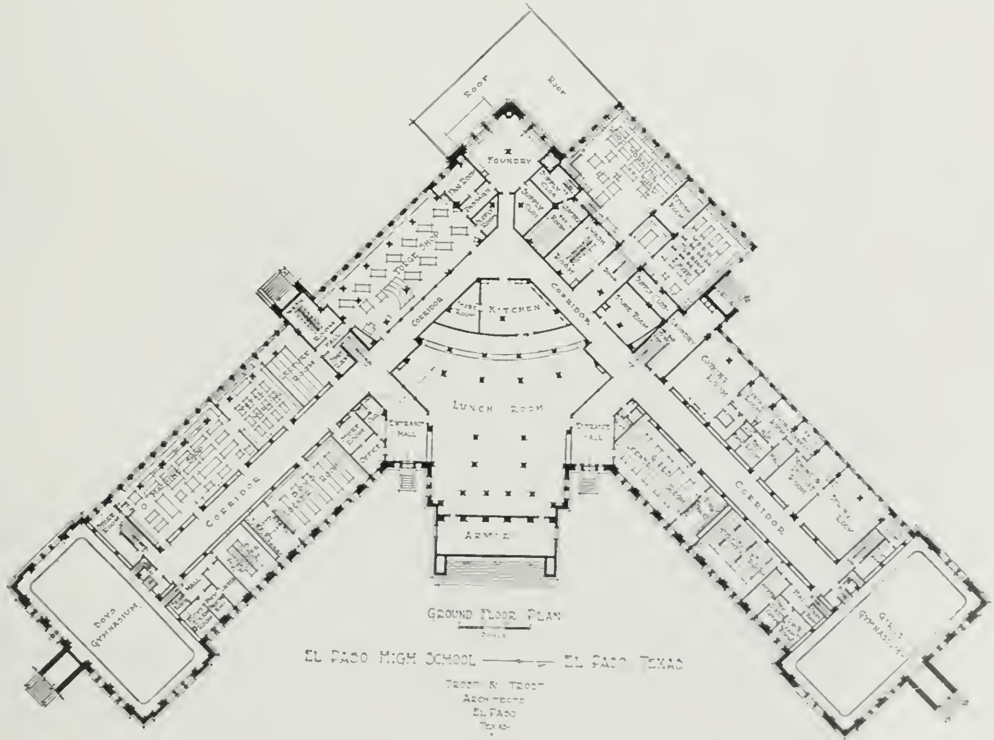
Trost & Trost, Architects, El Paso.



FIRST FLOOR PLAN

EL PASO HIGH SCHOOL — EL PASO TEXAS

TROST & TROST
ARCHITECTS
EL PASO
TEXAS



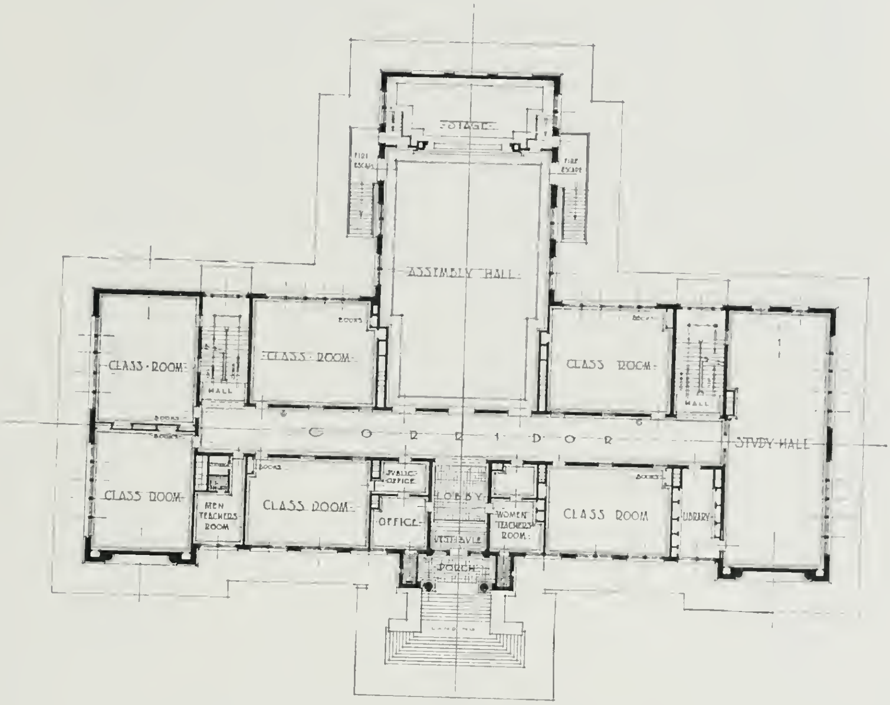
GROUND FLOOR PLAN

EL PASO HIGH SCHOOL — EL PASO TEXAS

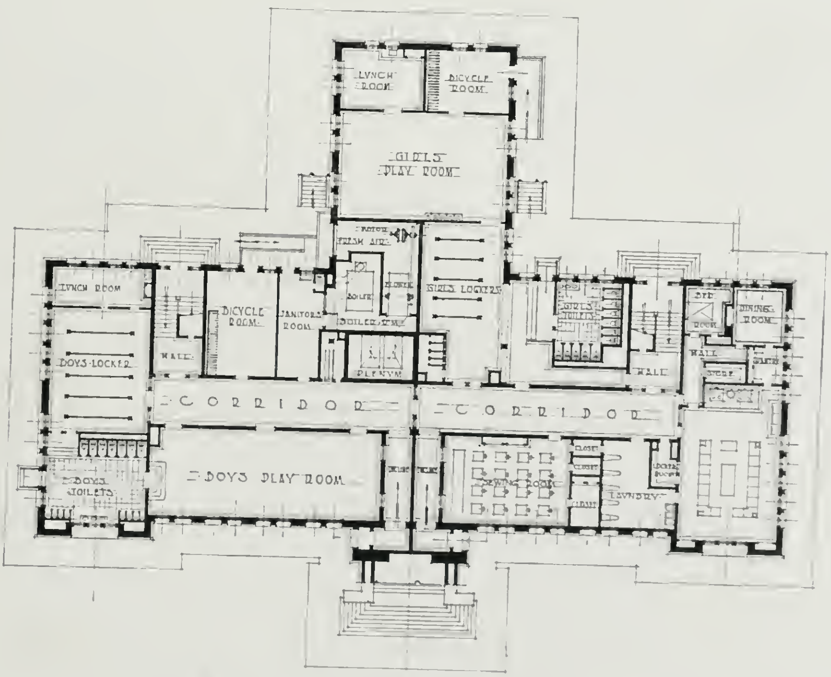
TROST & TROST
ARCHITECTS
EL PASO
TEXAS

HIGH SCHOOL, WOODLAND, CAL.

W. H. Weeks, Architect, San Francisco, Cal.



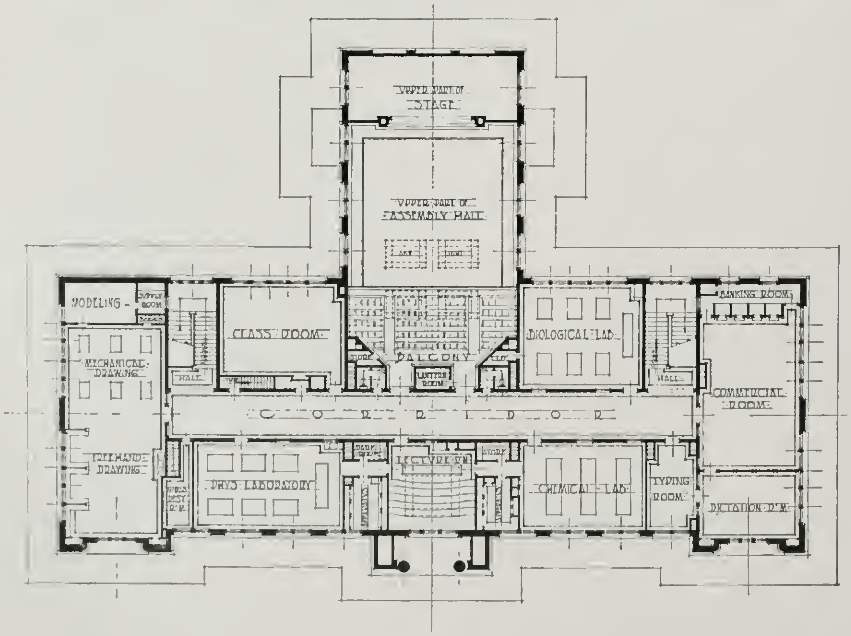
FIRST FLOOR PLAN, HIGH SCHOOL, WOODLAND, CAL.



BASEMENT PLAN, HIGH SCHOOL, WOODLAND, CAL.

W. H. Weeks, Architect, San Francisco, Cal.

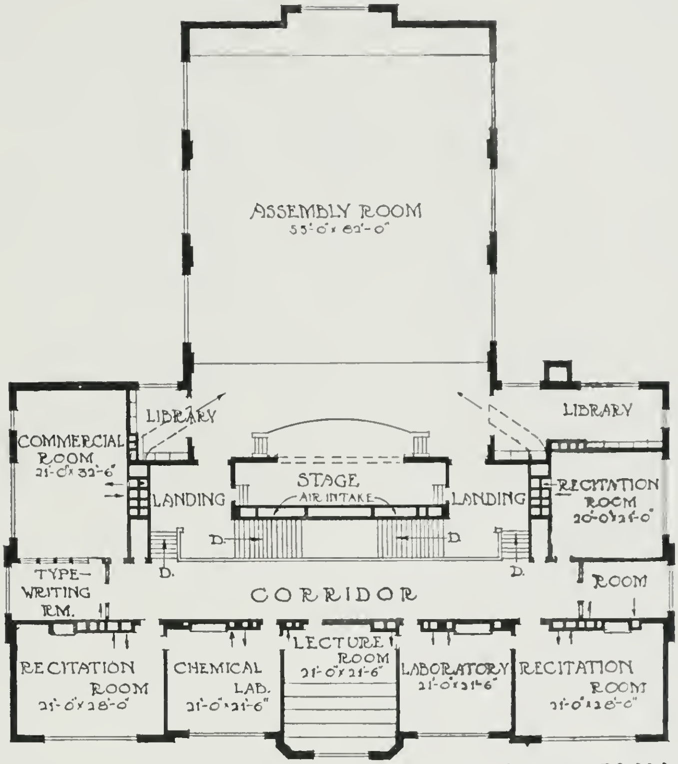
DETAIL OF FRONT ENTRANCE, HIGH SCHOOL, WOODLAND, CAL.



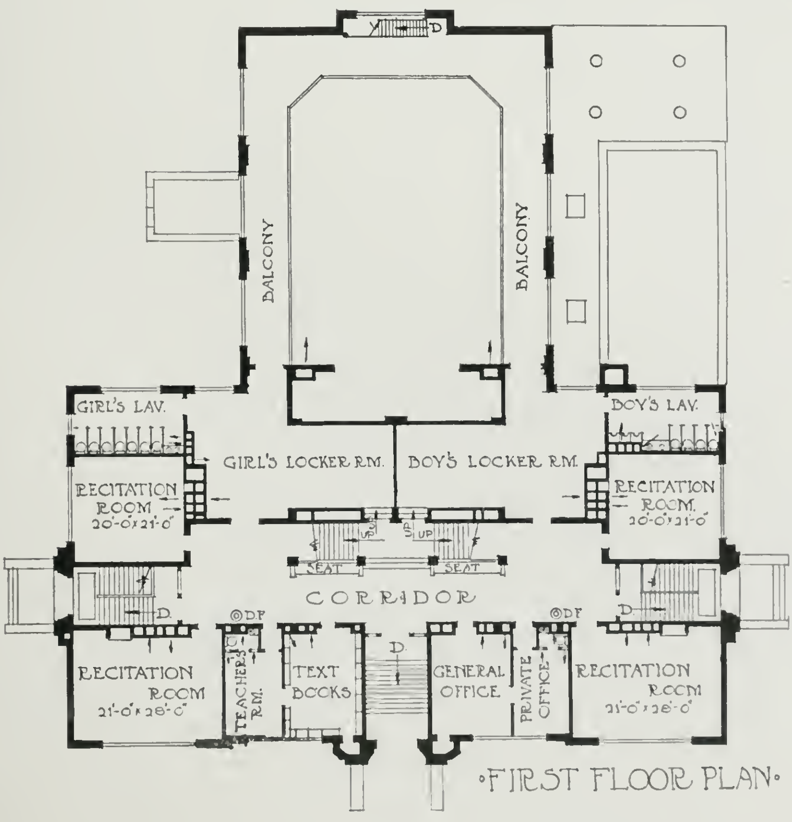
SECOND FLOOR PLAN, HIGH SCHOOL, WOODLAND, CAL.

FLOOR PLANS, HIGH SCHOOL, LADYSMITH, WIS.

Parkinson & Dockendorff, Architects, La Crosse, Wis.



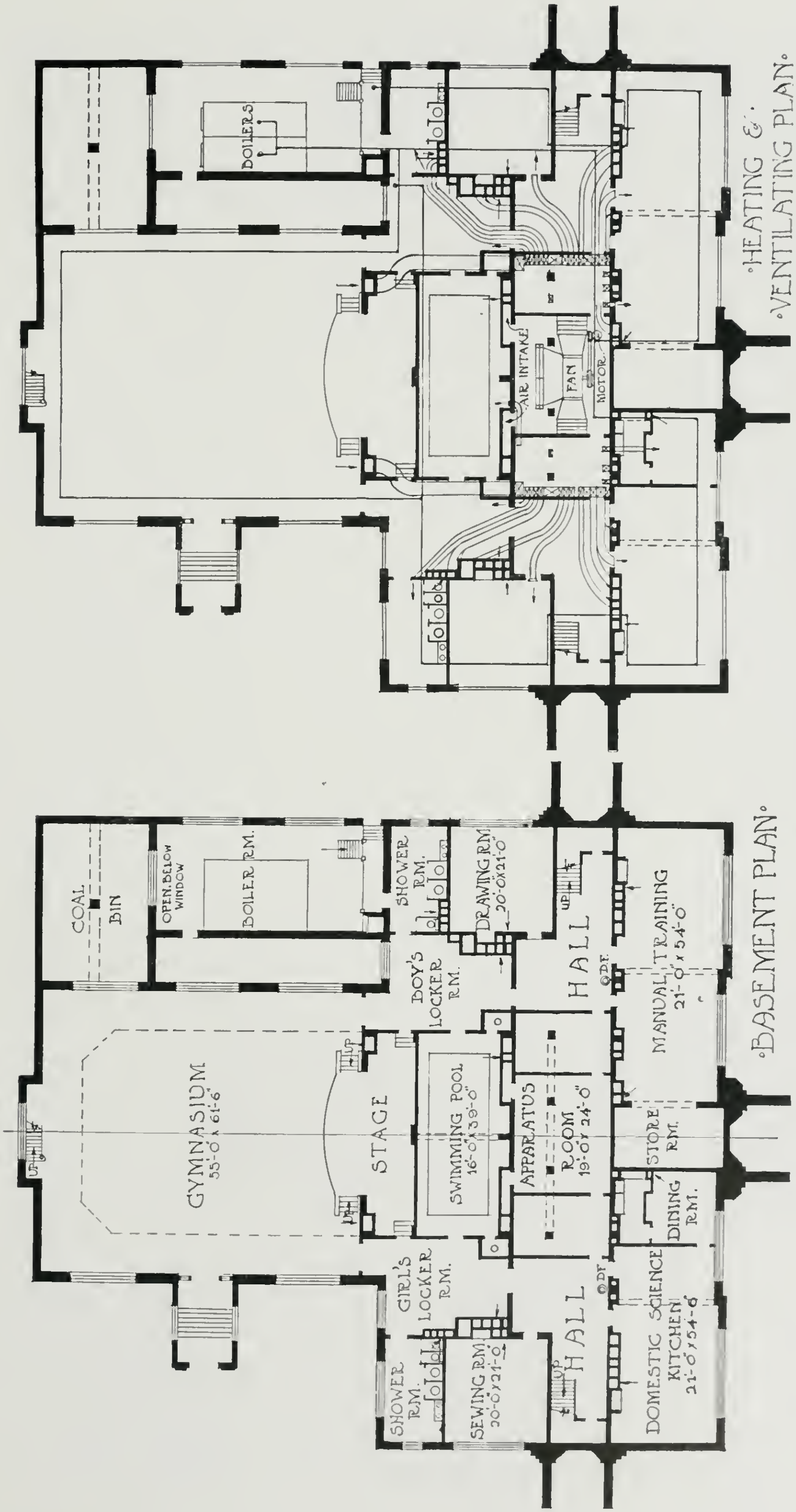
·SECOND FLOOR PLAN·



·FIRST FLOOR PLAN·

HIGH SCHOOL, LADYSMITH, WIS.

Parkinson & Dockendorff, Architects, La Crosse, Wis.



FLOOR PLANS OF THE HIGH SCHOOL, LADYSMITH, WIS.

Parkinson & Dockendorff, Architects, La Crosse, Wis.

HIGH SCHOOL, WEST SPRINGFIELD, MASS.
Malcom B. Harding, Architect, Westfield, Mass.

SECOND FLOOR PLAN

BASEMENT PLAN

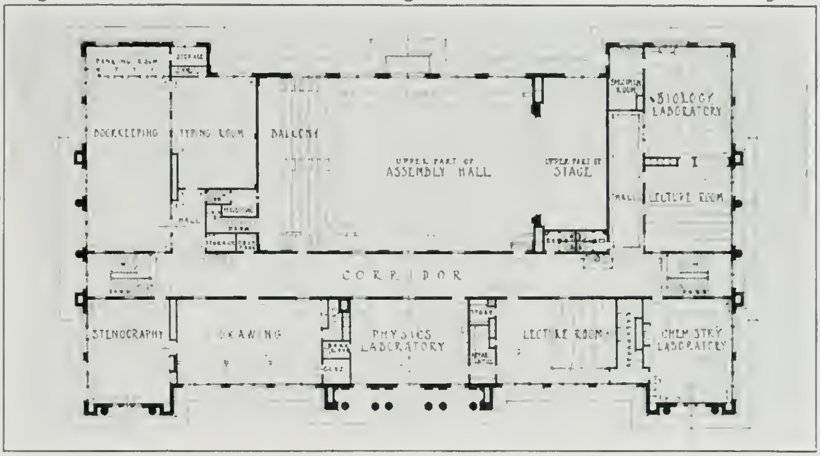
THIRD FLOOR PLAN

FIRST FLOOR PLAN

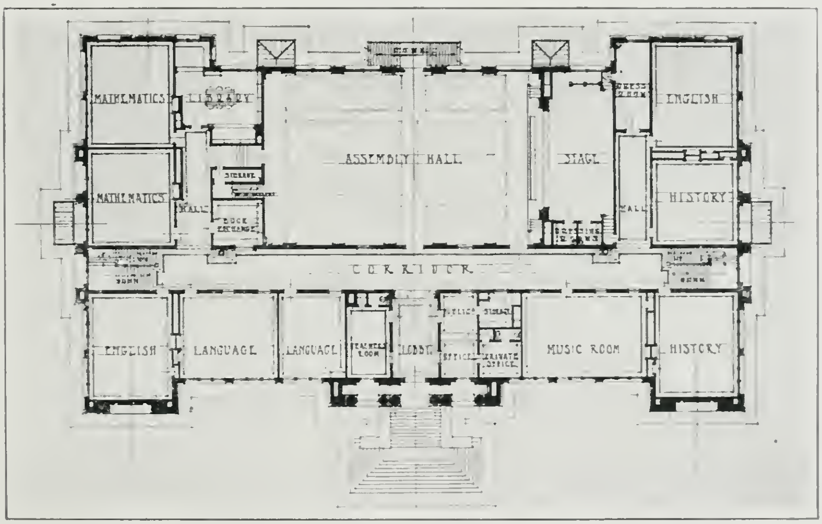
FLOOR PLANS, HIGH SCHOOL, WEST SPRINGFIELD, MASS.

HIGH SCHOOL, SANTA CRUZ, CAL.

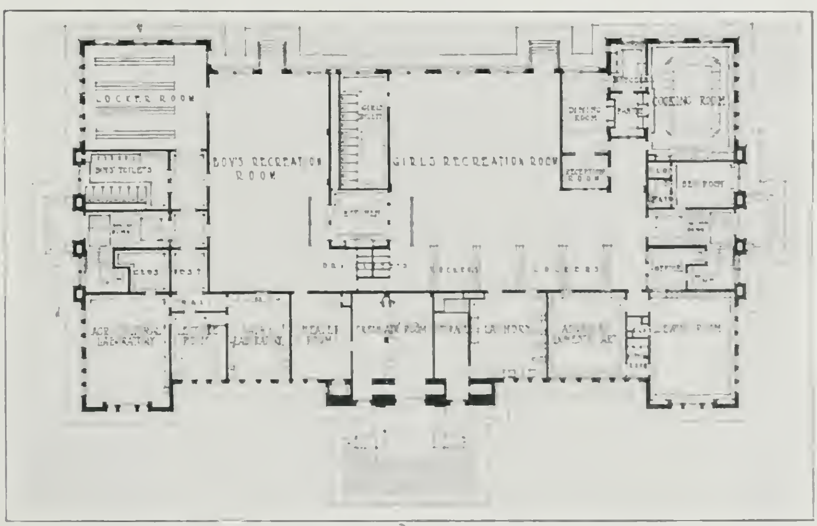
W. H. Weeks, Architect, San Francisco, Cal.



SECOND FLOOR PLAN, HIGH SCHOOL, SANTA CRUZ, CAL.



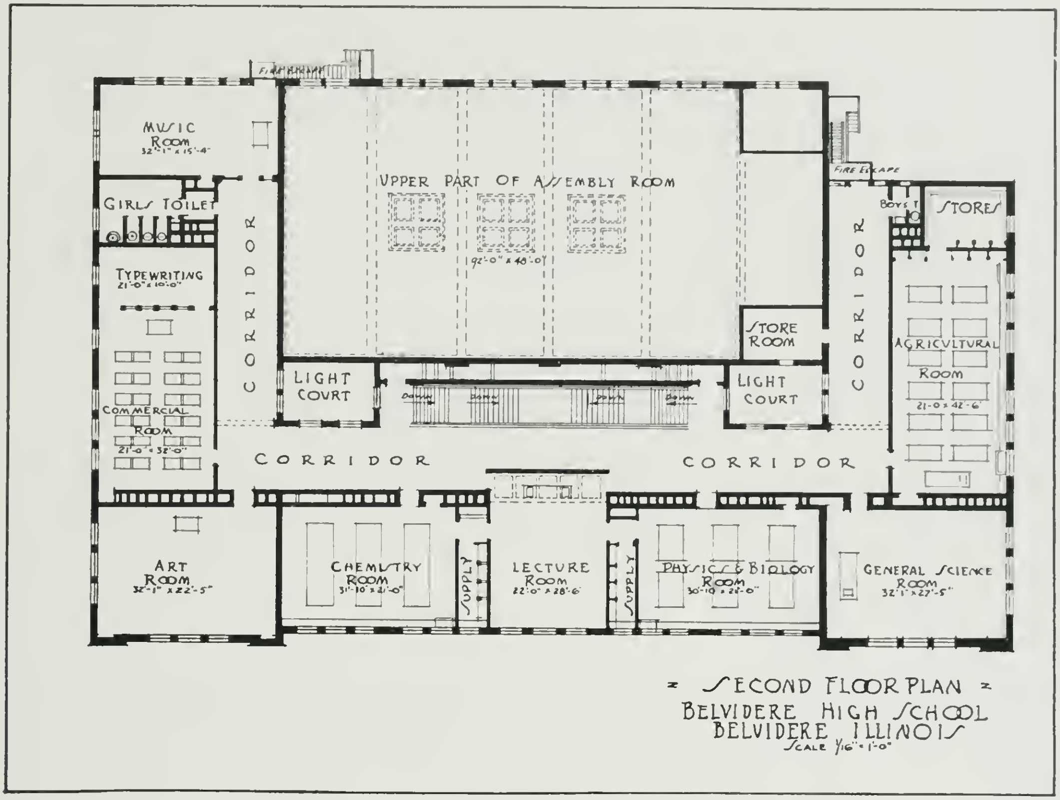
FIRST FLOOR PLAN, HIGH SCHOOL, SANTA CRUZ, CAL.

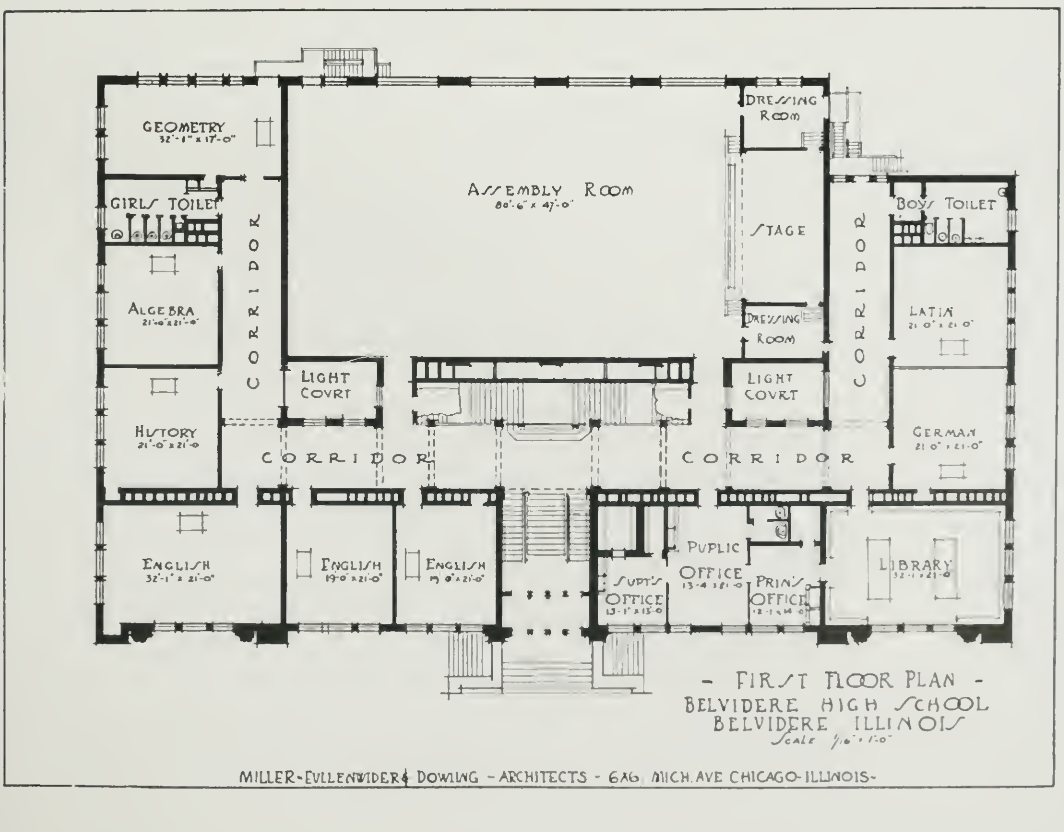


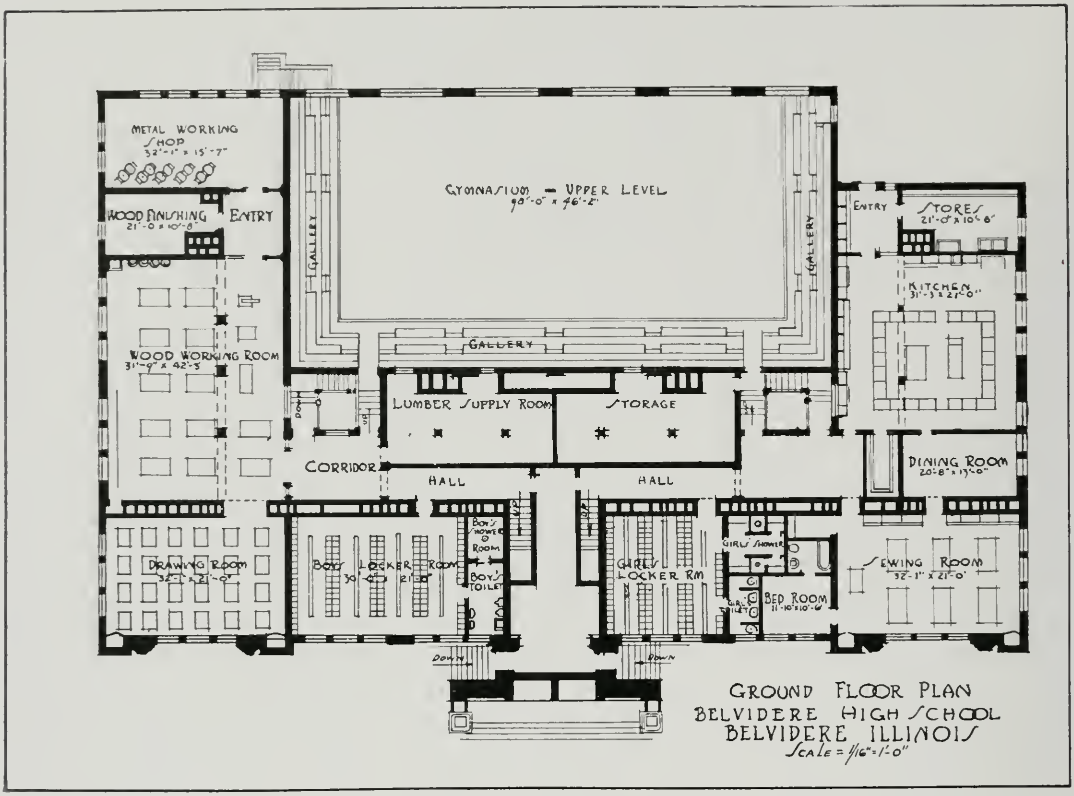
BASEMENT PLAN, HIGH SCHOOL, SANTA CRUZ, CAL.

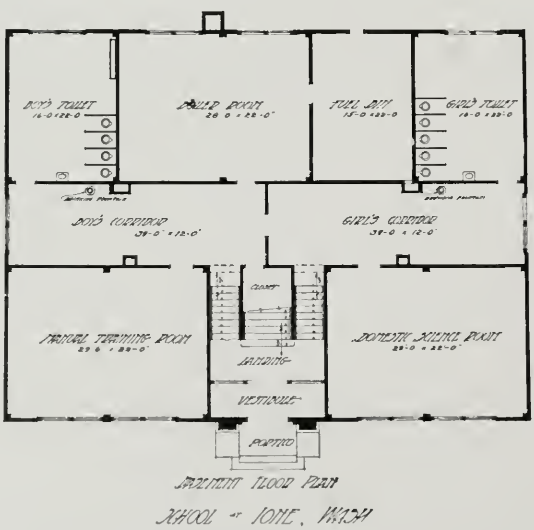
HIGH SCHOOL, BELVIDERE, ILL.

Miller, Fullenwider & Dowling, Architects. Chicago, Ill.


MUSIC ROOM
32'-1" x 15'-4"
GIRLS TOILET
TYPEWRITING
21'-0" x 10'-0"
COMMERCIAL ROOM
21'-0" x 32'-0"
CORRIDOR
UPPER PART OF ASSEMBLY ROOM
92'-0" x 48'-0"
LIGHT COURT
DOWN
STORE ROOM
LIGHT COURT
FIRE ESCAPE
BOYS T
STORES
CORRIDOR
AGRICULTURAL ROOM
21-0 x 42-6
CORRIDOR
CORRIDOR
ART ROOM
32'-1" x 22'-5"
CHEMISTRY ROOM
31'-10" x 21'-0"
SUPPLY
LECTURE ROOM
22'-0" x 28'-6"
SUPPLY
PHYSICS & BIOLOGY ROOM
30'-10" x 28'-0"
GENERAL SCIENCE ROOM
32'-1" x 27'-5"
= SECOND FLOOR PLAN =
BELVIDERE HIGH SCHOOL
BELVIDERE ILLINOIS
SCALE 1/16" = 1'-0"


GEOMETRY
32'-1" x 17'-0"
GIRLS TOILET
ALGEBRA
21'-0" x 21'-0"
HISTORY
21'-0" x 21'-0
CORRIDOR
ASSEMBLY ROOM
80'-6" x 47'-0"
DRESSING ROOM
STAGE
DRESSING ROOM
LIGHT COURT
LIGHT COURT
BOYS TOILET
CORRIDOR
LATIN
21'-0" x 21'-0"
GERMAN
21'-0" x 21'-0"
CORRIDOR
CORRIDOR
ENGLISH
32'-1" x 21'-0"
ENGLISH
19'-0" x 21'-0"
ENGLISH
19'-0" x 21'-0"
PUBLIC OFFICE
13-4 x 21-0
SUPT'S OFFICE
13-1" x 15-0
PRIN'S OFFICE
12-1 x 14-0
LIBRARY
32-1 x 21-0
- FIRST FLOOR PLAN -
BELVIDERE HIGH SCHOOL
BELVIDERE ILLINOIS
SCALE 1/16" = 1'-0"
MILLER-FULLENWIDER & DOWLING - ARCHITECTS - 6A6 MICH. AVE CHICAGO-ILLINOIS-



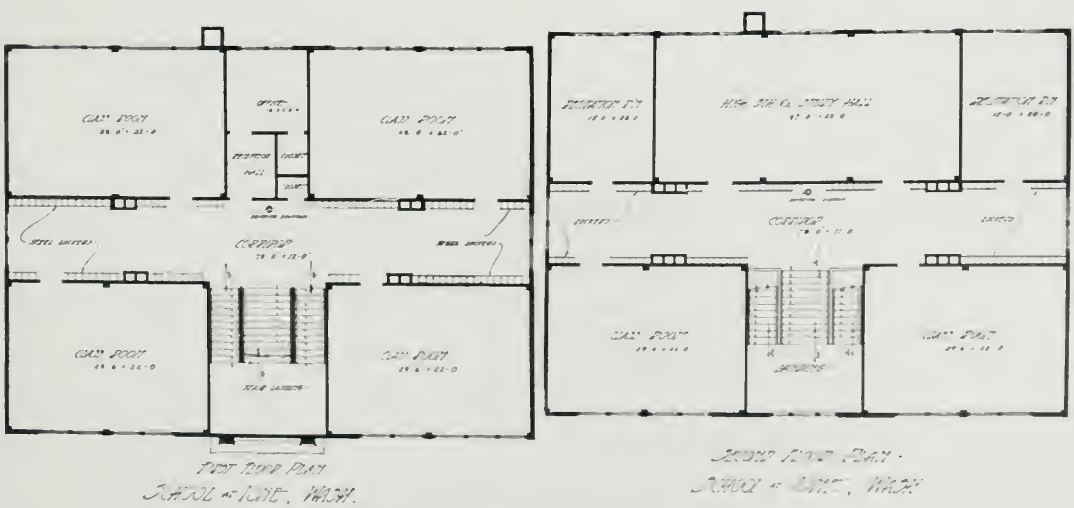


BASEMENT PLAN, HIGH SCHOOL, IONE, WASH.

Keith & Whitehouse, Architects, Spokane, Wash.

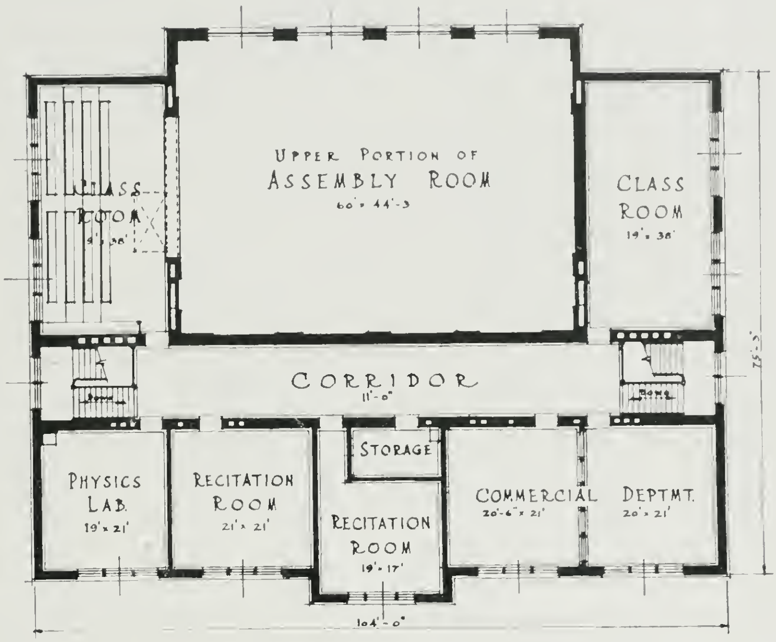
HIGH SCHOOL, IONE, WASH.

Keith & Whitehouse, Architects, Spokane, Wash.

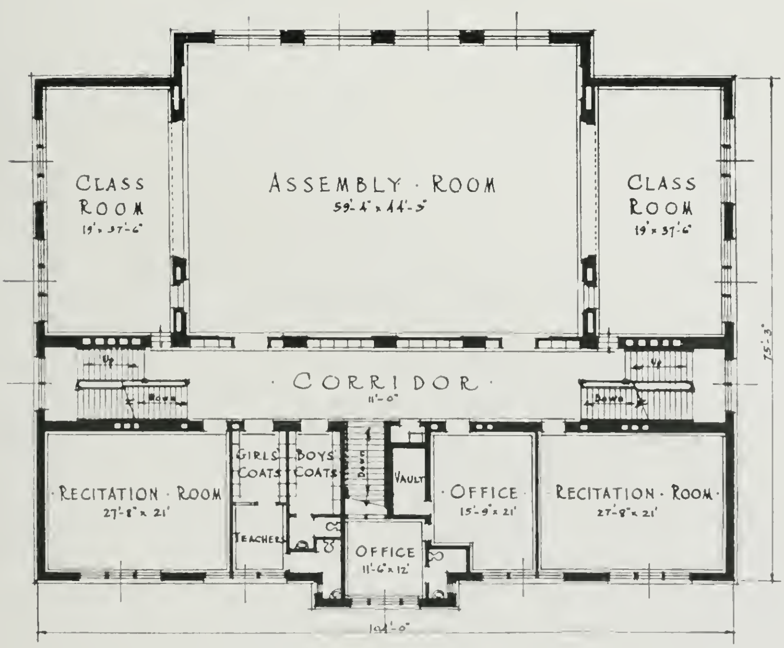


FLOOR PLANS, HIGH SCHOOL, IONE, WASH.

HIGH SCHOOL, LAKE MILLS, WIS.
James R. Law, Architect, Madison, Wis.



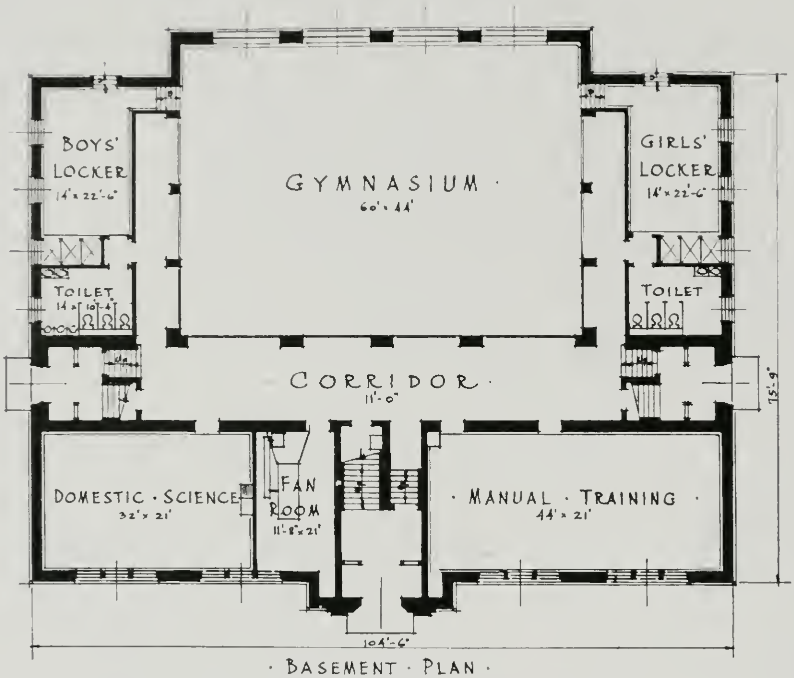
· SECOND · FLOOR · PLAN



· FIRST FLOOR PLAN ·

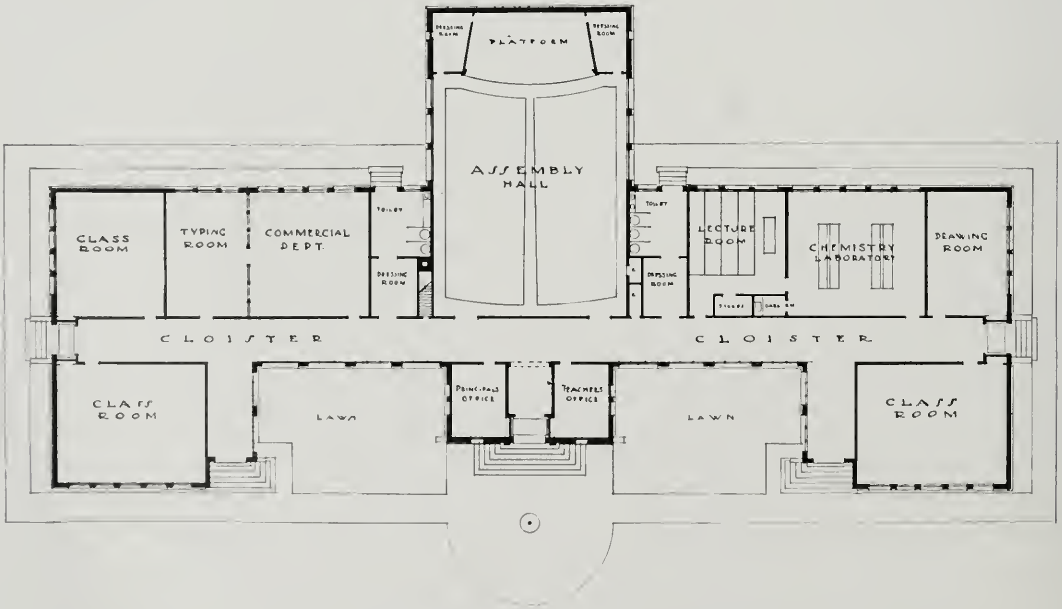
FLOOR PLANS, HIGH SCHOOL, LAKE MILLS, WIS.

James R. Law, Architect, Madison, Wis.



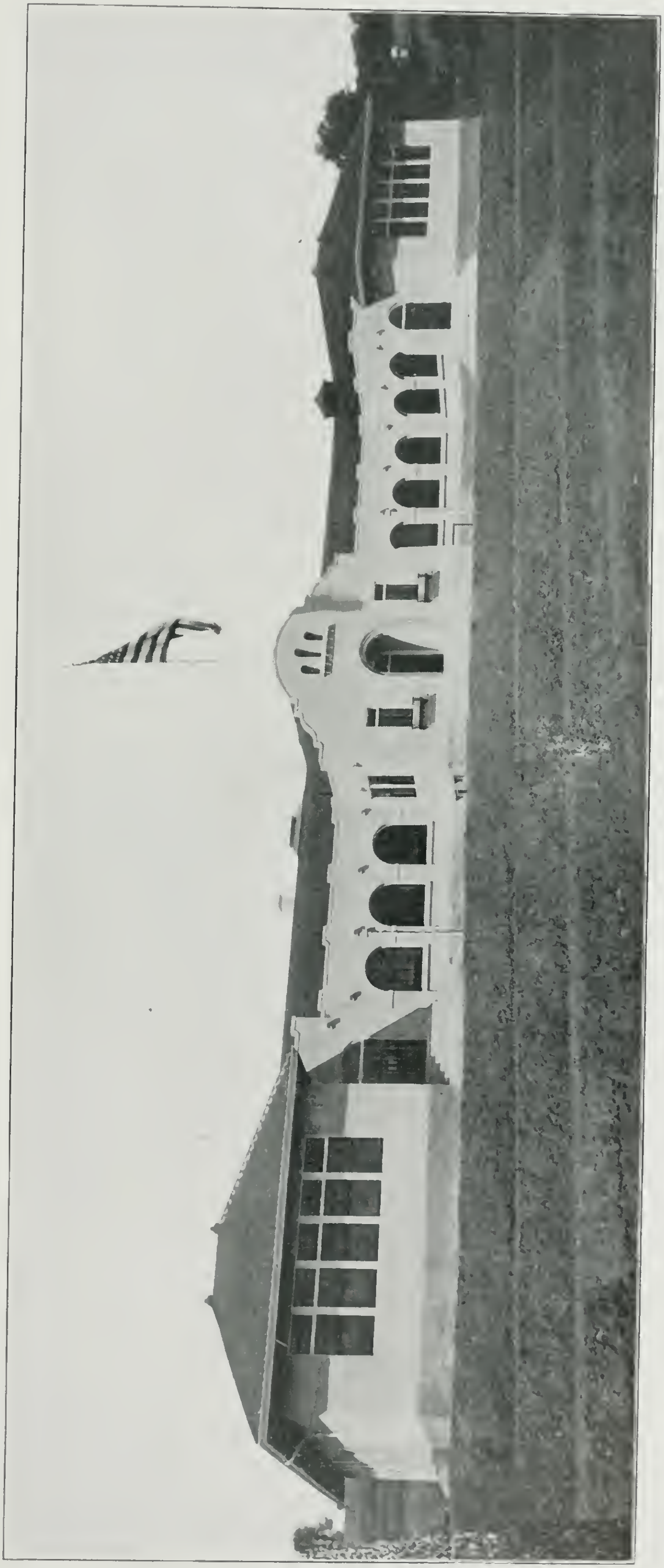
BASEMENT PLAN, HIGH SCHOOL, LAKE MILLS, WIS.

James R. Law, Architect, Madison, Wis.



FLOOR PLAN, UNION HIGH SCHOOL, JACKSON, CAL.

Walter Parker & Co., Architects, San Francisco, Cal.

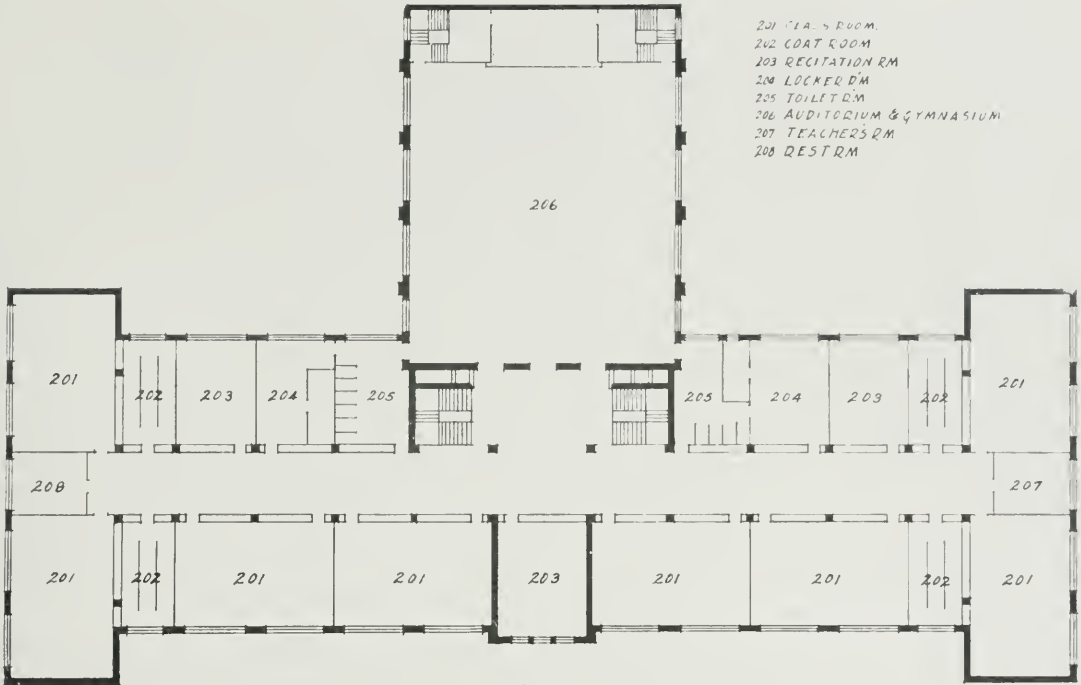


UNION HIGH SCHOOL, JACKSON, CAL.

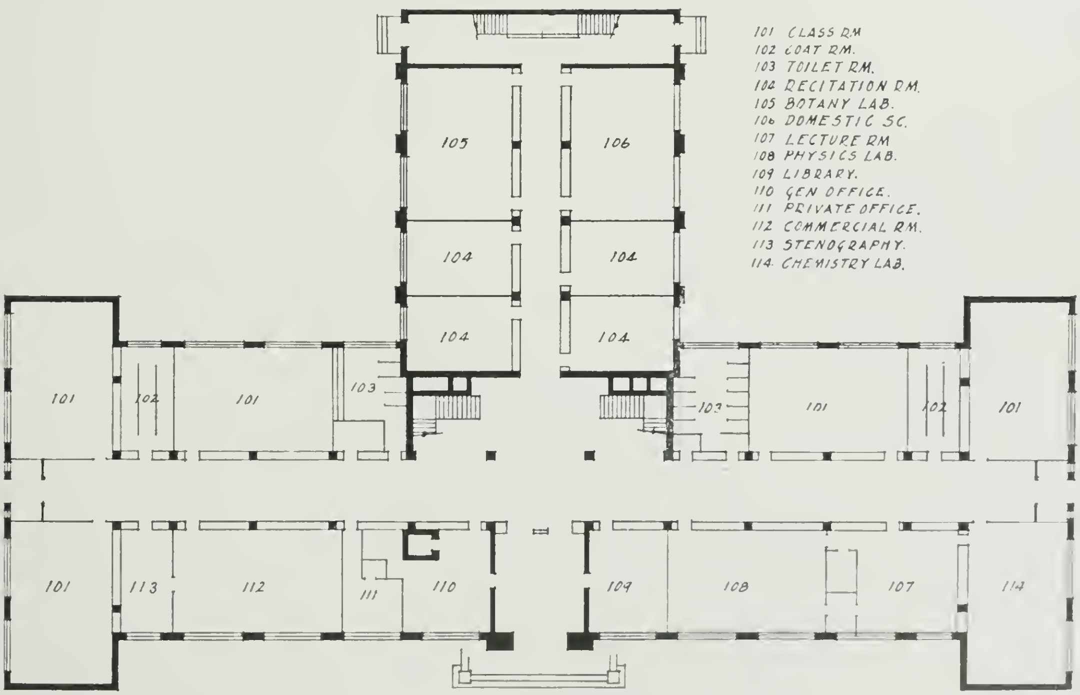
Walter Parker & Co., Architects, San Francisco, Cal.

HIGH SCHOOL, STURGIS, MICH.

Robinson & Campau, Architects, Grand Rapids, Mich.



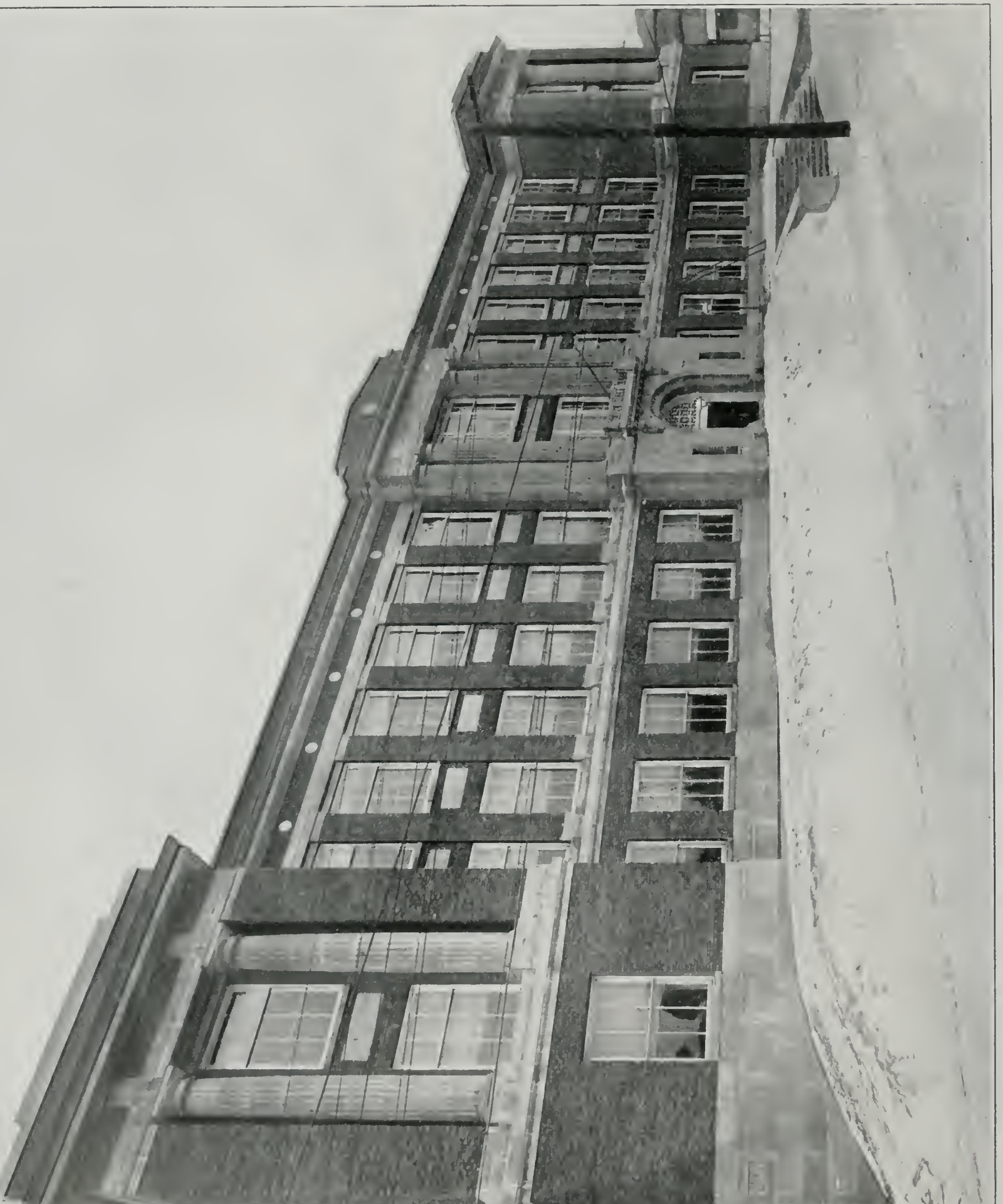
SECOND FLOOR PLAN.



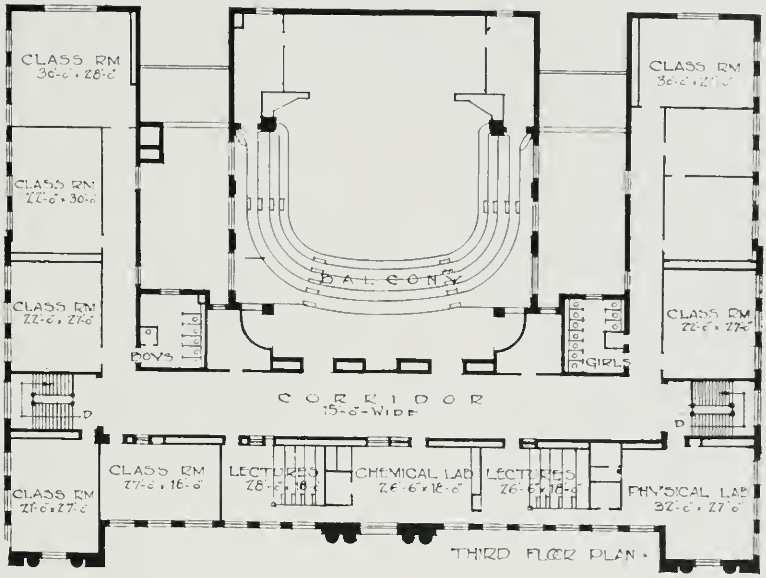
FIRST FLOOR PLAN

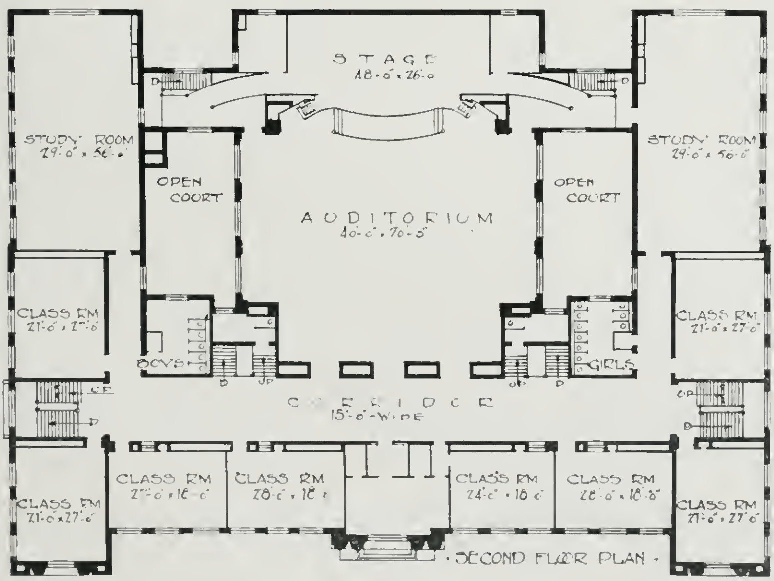
FLOOR PLANS, HIGH SCHOOL, STURGIS, MICH.

Robinson & Campau, Architects, Grand Rapids, Mich.



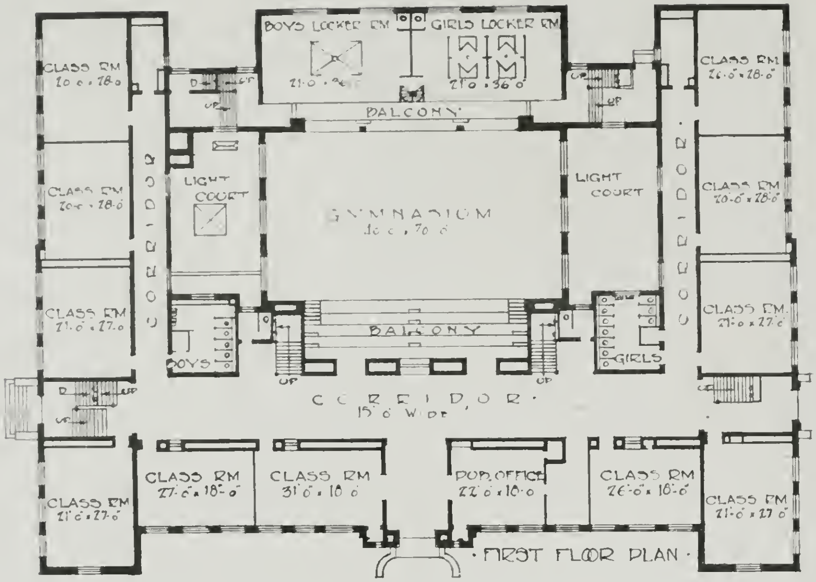
HIGH SCHOOL, CONNELLSVILLE, PA.
W. G. Eckles, Architect, New Castle, Pa.





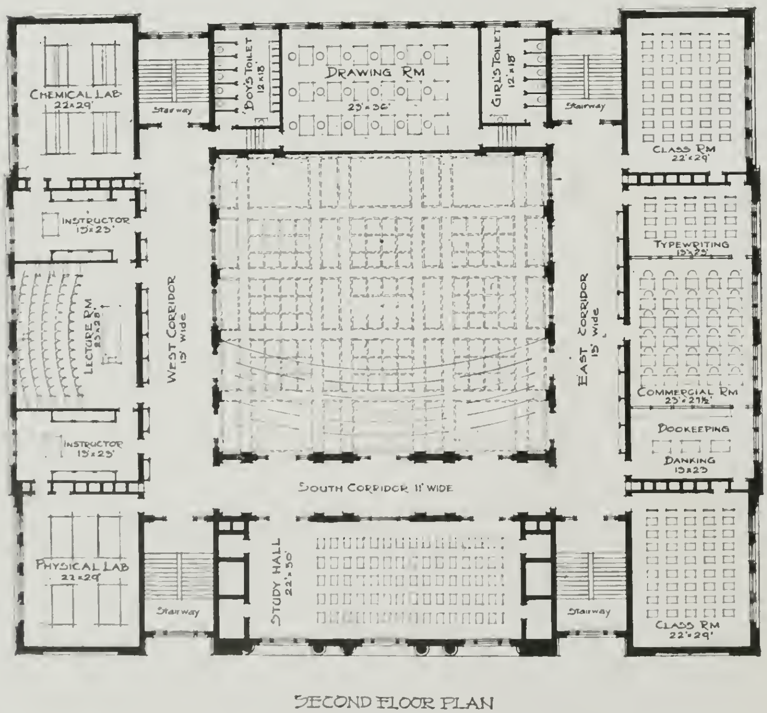
FLOOR PLANS, HIGH SCHOOL, CONNELLSVILLE, PA.

W. G. Eckles, Architect, New Castle, Pa.



FIRST FLOOR PLAN, HIGH SCHOOL, CONNELLSVILLE, PA.

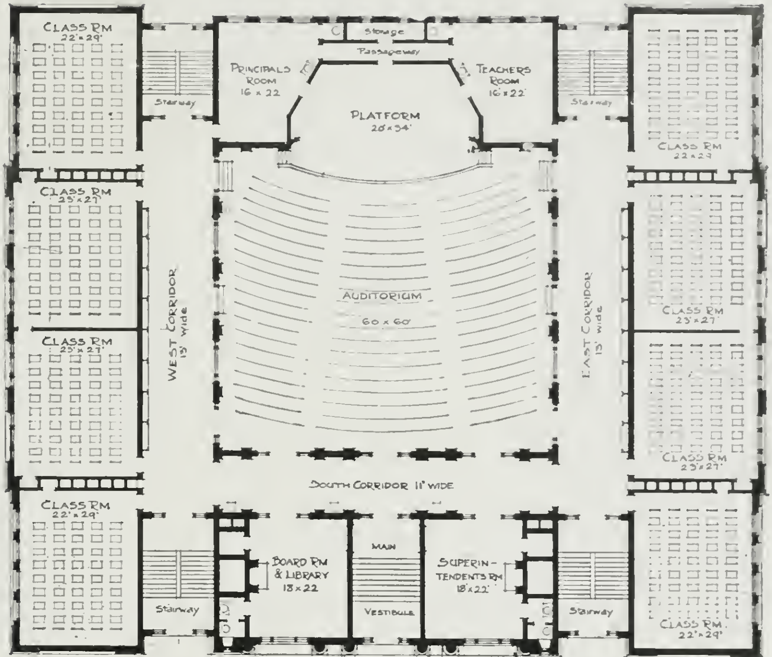
W. G. Eckles, Architect, New Castle, Pa.



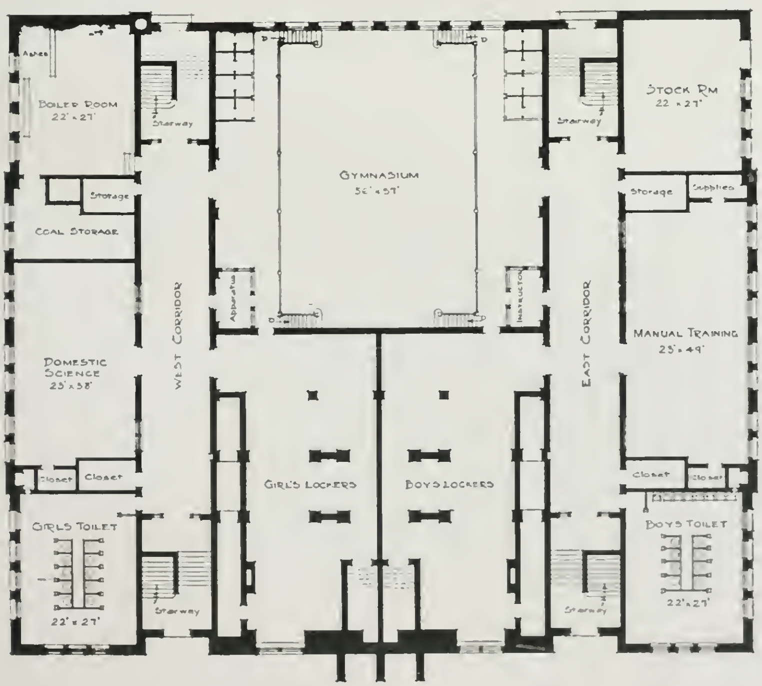
SECOND FLOOR PLAN, HIGH SCHOOL, MT. CARMEL, PA.

Clyde S. Adams, Architect, Philadelphia, Pa.

FLOOR PLANS,
HIGH SCHOOL,
MOUNT CARMEL, PA.



FIRST FLOOR PLAN



BASEMENT PLAN

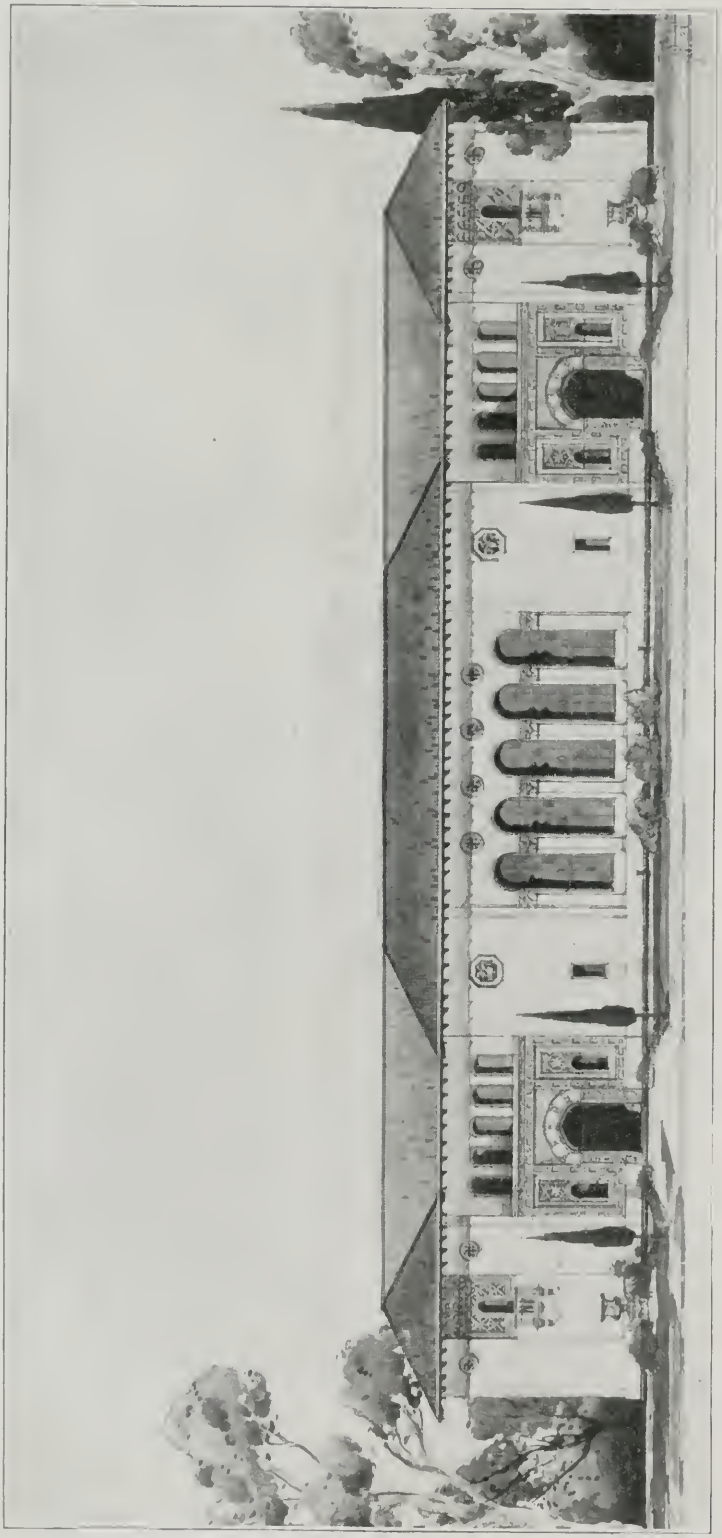
Clyde S. Adams, Architect,
Philadelphia, Pa.

HIGH SCHOOL, MOUNT CARMEL, PA.

Clyde S. Adams, Architect, Philadelphia, Pa.

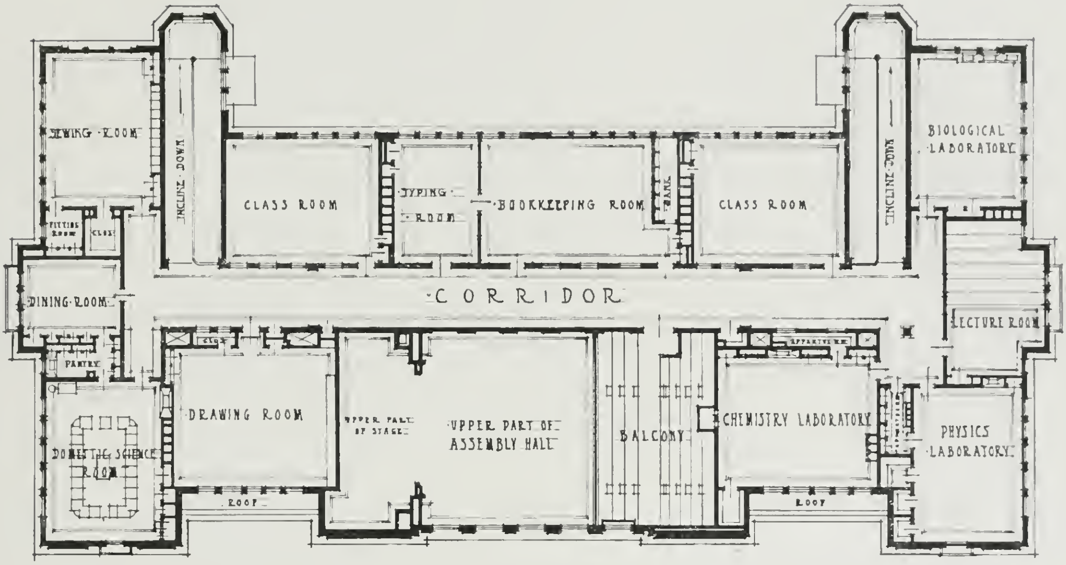
DETAIL OF ENTRANCE, HIGH SCHOOL, WATSONVILLE, CAL.

PLAT PLAN, HIGH SCHOOL, WATSONVILLE, CAL.
W. H. Weeks, Architect, San Francisco, Cal.

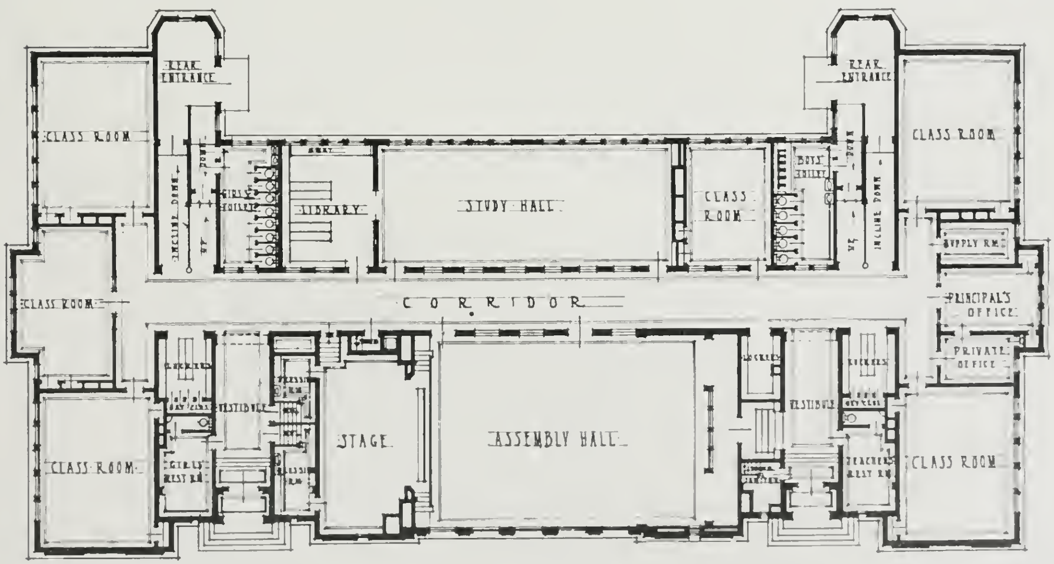


HIGH SCHOOL, WATSONVILLE, CAL.

W. H. Weeks, Architect, San Francisco, Cal.



SECOND FLOOR PLAN, HIGH SCHOOL, WATSONVILLE, CAL.

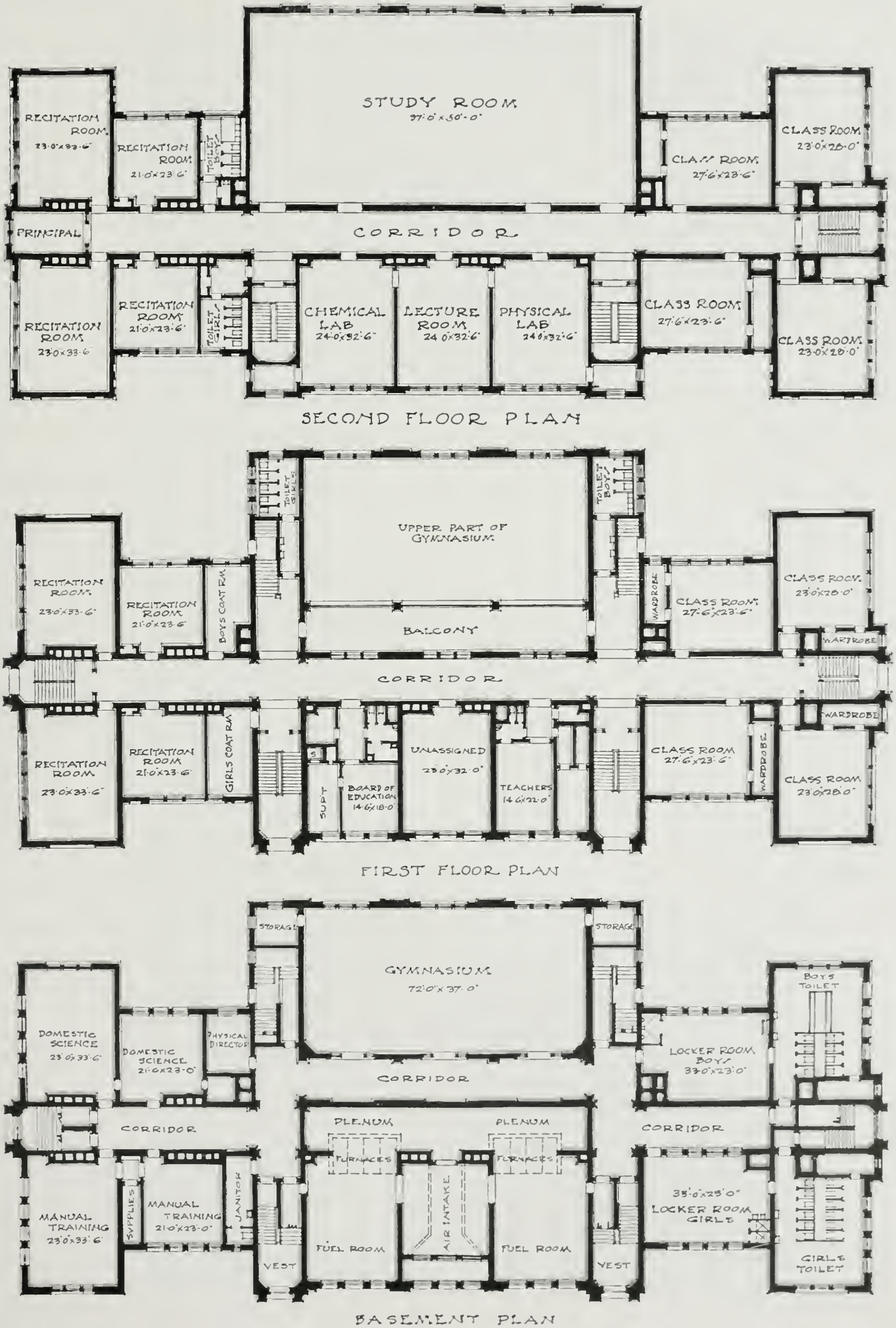


FIRST FLOOR PLAN, HIGH SCHOOL, WATSONVILLE, CAL.

W. H. Weeks, Architect, San Francisco, Cal.

HIGH SCHOOL, VAN WERT, O.

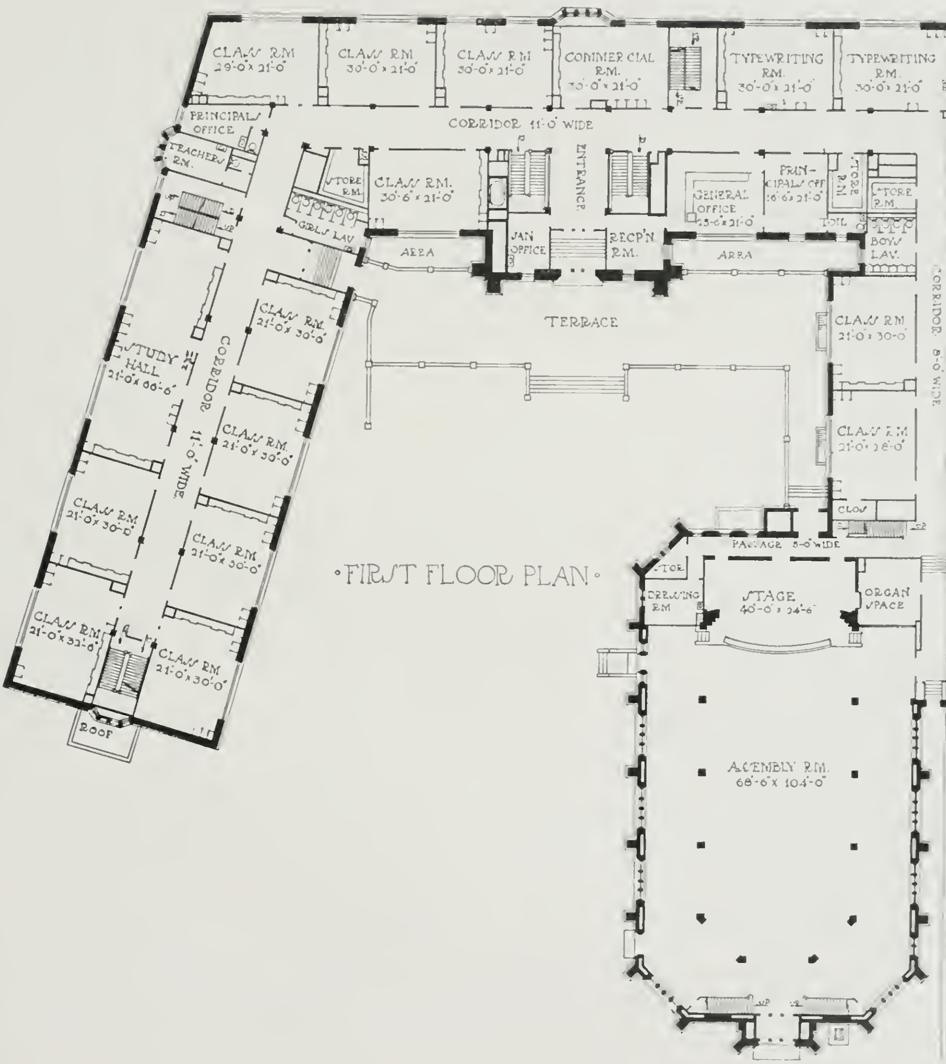
Frank L. Packard, Architect, Columbus, O.



FLOOR PLANS, HIGH SCHOOL, VAN WERT, O.
Frank L. Packard, Architect, Columbus, O.

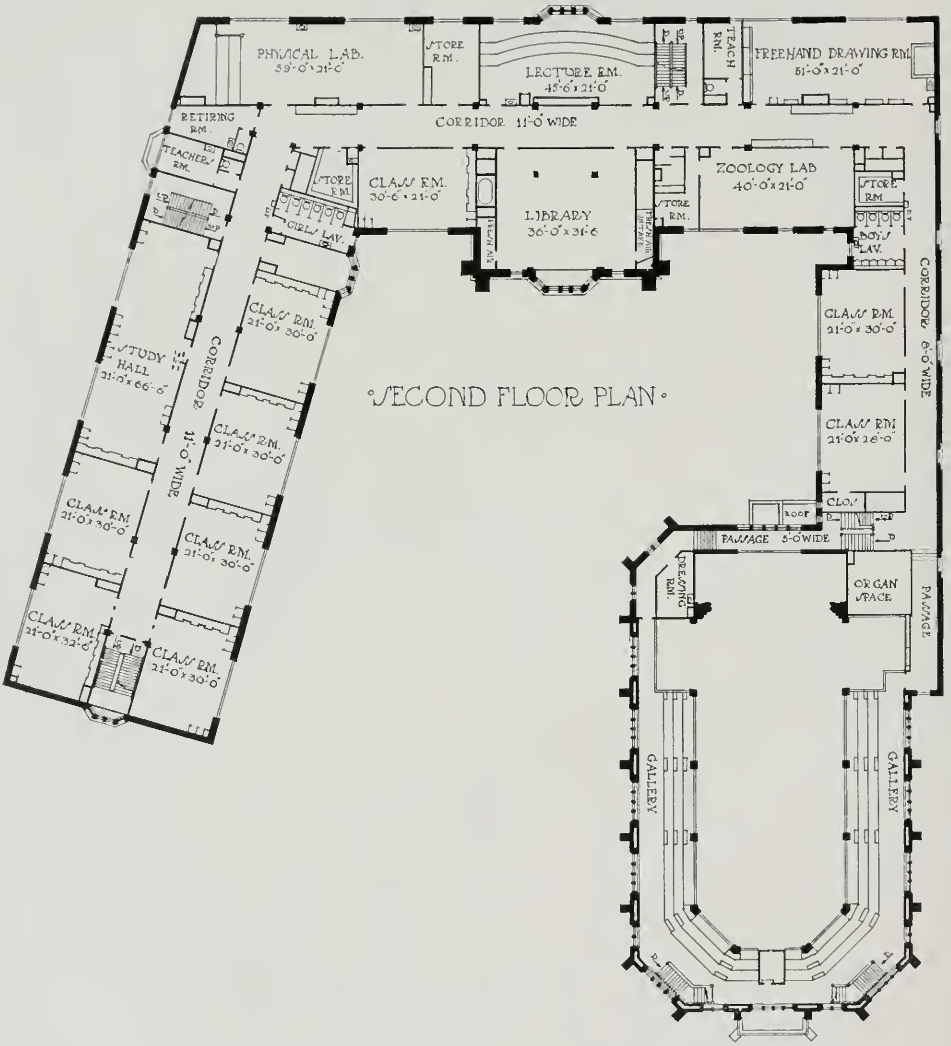
FLUSHING HIGH SCHOOL, BOROUGH OF QUEENS, NEW YORK, N. Y.

C. B. J. Snyder, Architect and Supt. of Buildings, for the Board of Education, New York, N. Y.



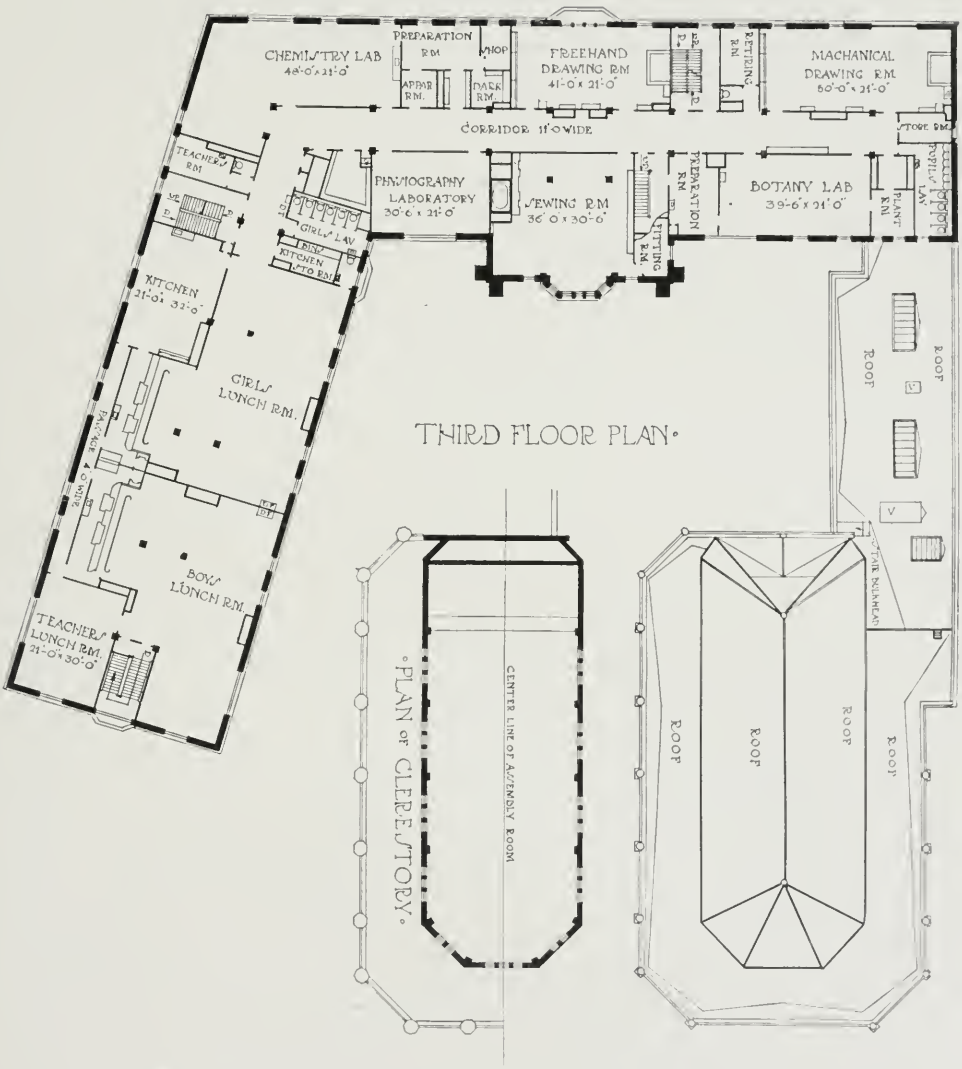
FIRST FLOOR PLAN, FLUSHING HIGH SCHOOL, BOROUGH OF QUEENS, NEW YORK, N. Y.

C. B. J. Snyder, Architect and Supt. of Buildings, for the Board of Education, New York, N. Y.

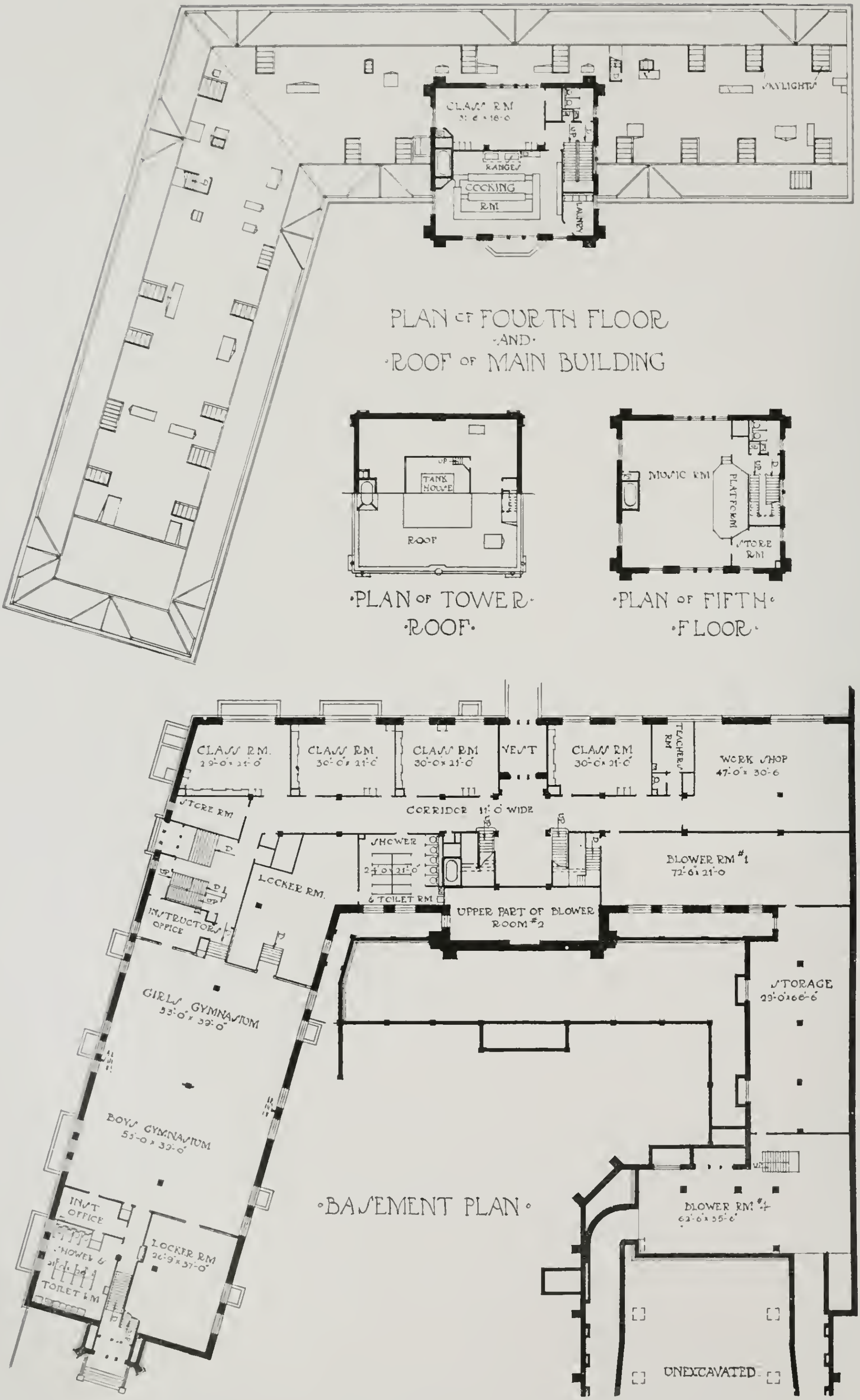


SECOND FLOOR PLAN, FLUSHING HIGH SCHOOL, BOROUGH OF QUEENS, NEW YORK, N. Y.

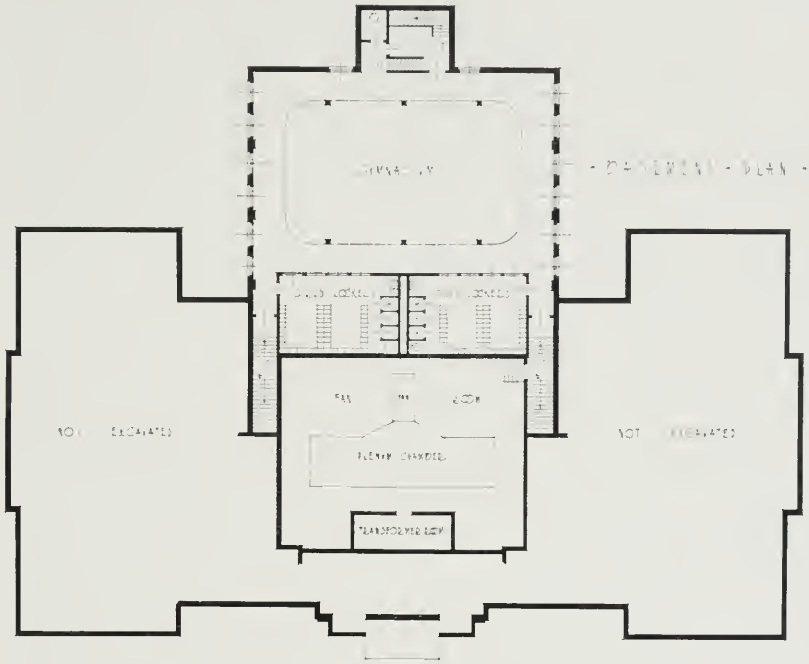
C. B. J. Snyder, Architect and Superintendent of Buildings for the Board of Education, New York, N. Y.

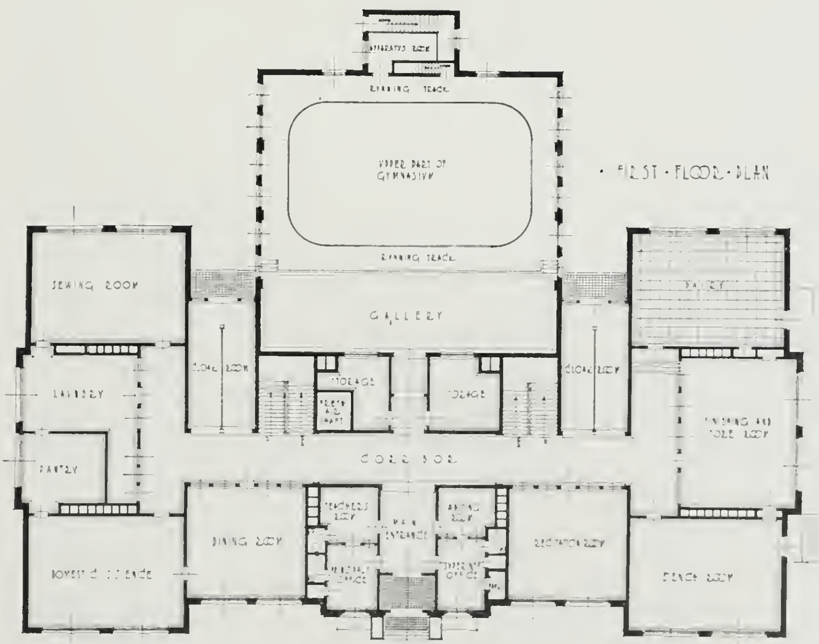


THIRD FLOOR PLAN, FLUSHING HIGH SCHOOL, BOROUGH OF QUEENS, NEW YORK, N. Y.
C. B. J. Snyder, Architect and Superintendent of Buildings for the Board of Education, New York, N. Y.



FLOOR PLANS, FLUSHING HIGH SCHOOL, NEW YORK, N. Y.

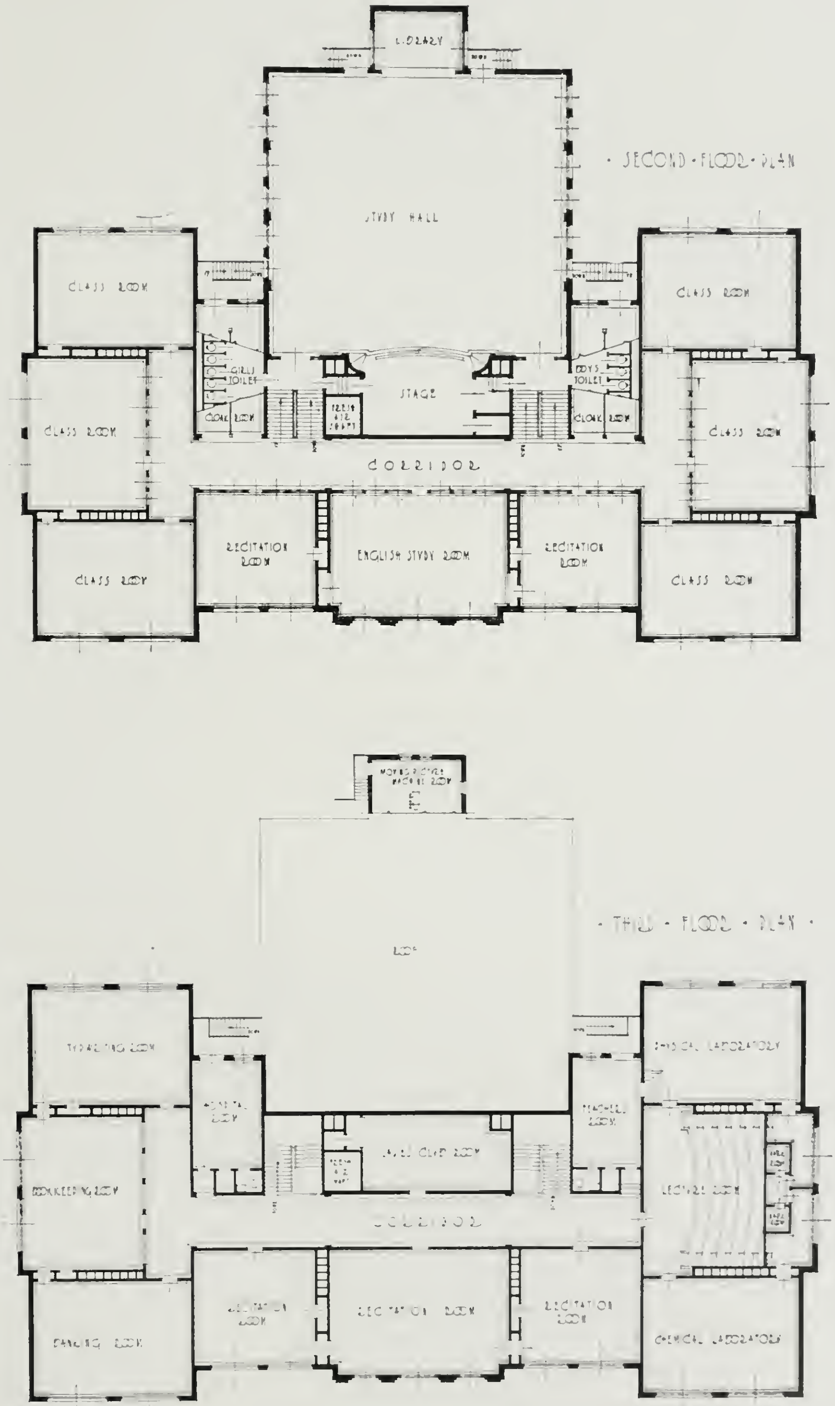




FLOOR PLANS, HIGH SCHOOL, BURLEY, IDA.

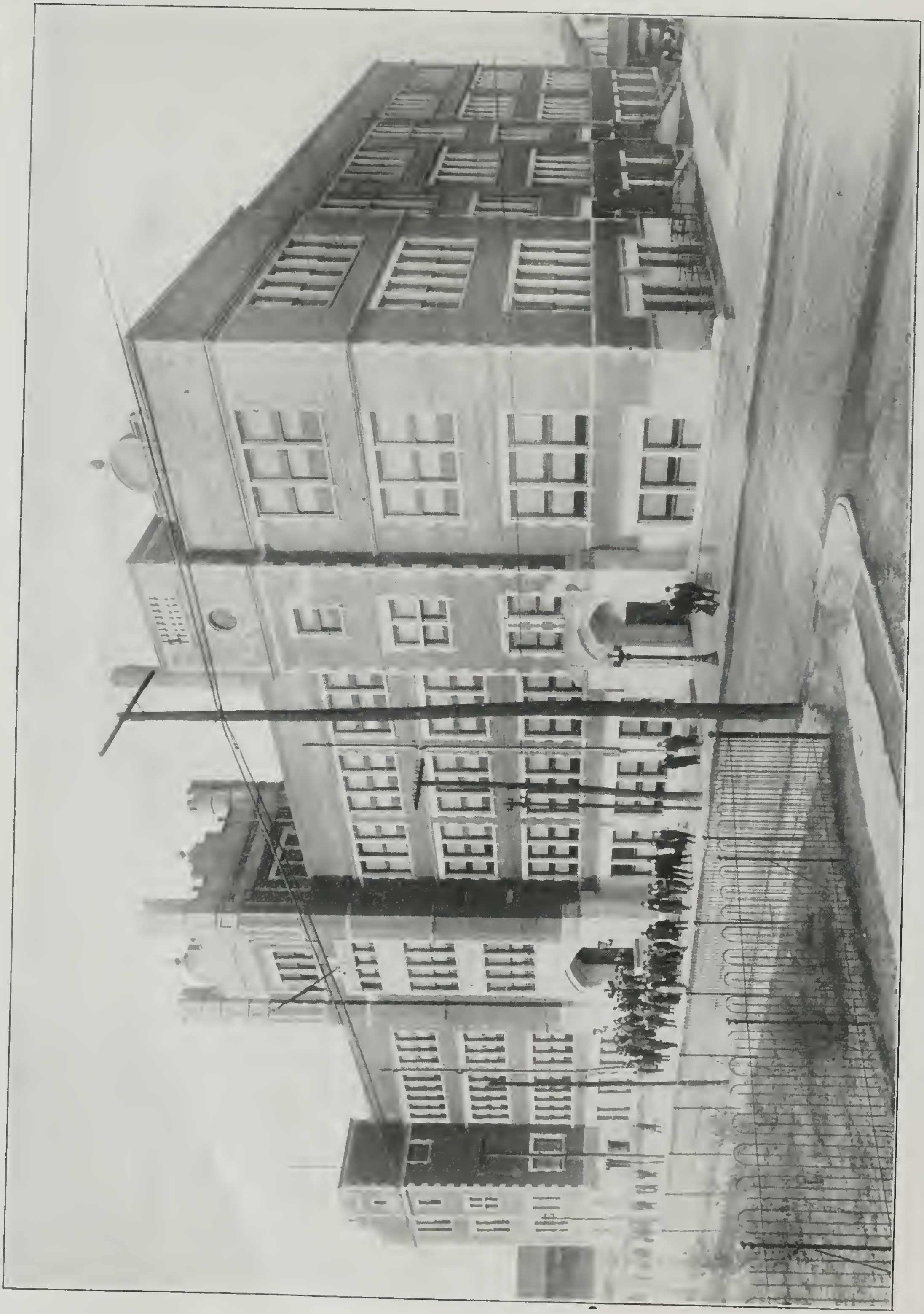
C. L. Wilson, Architect, Butte, Mont.

HIGH SCHOOL, BURLEY, IDA.
C. L. Wilson, Architect, Butte, Mont.

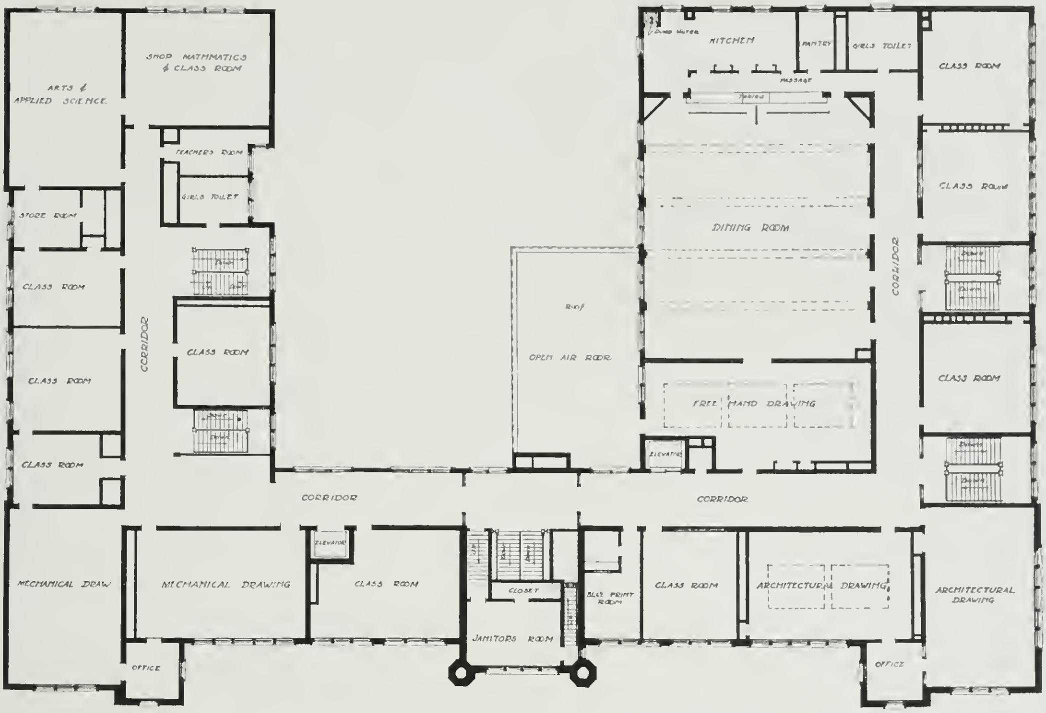


FLOOR PLANS, HIGH SCHOOL, BURLEY, IDA.

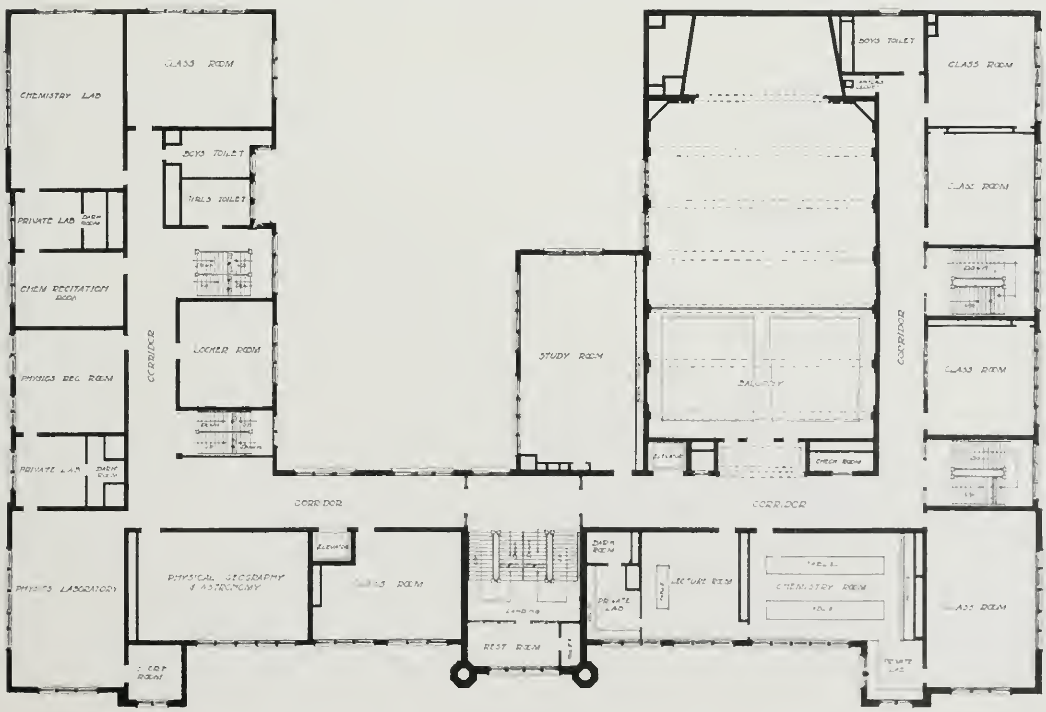
C. L. Wilson, Architect, Butte, Mont.



STIVERS HIGH SCHOOL, DAYTON, O.
E. J. Mounstephen, Architect, Dayton, O.

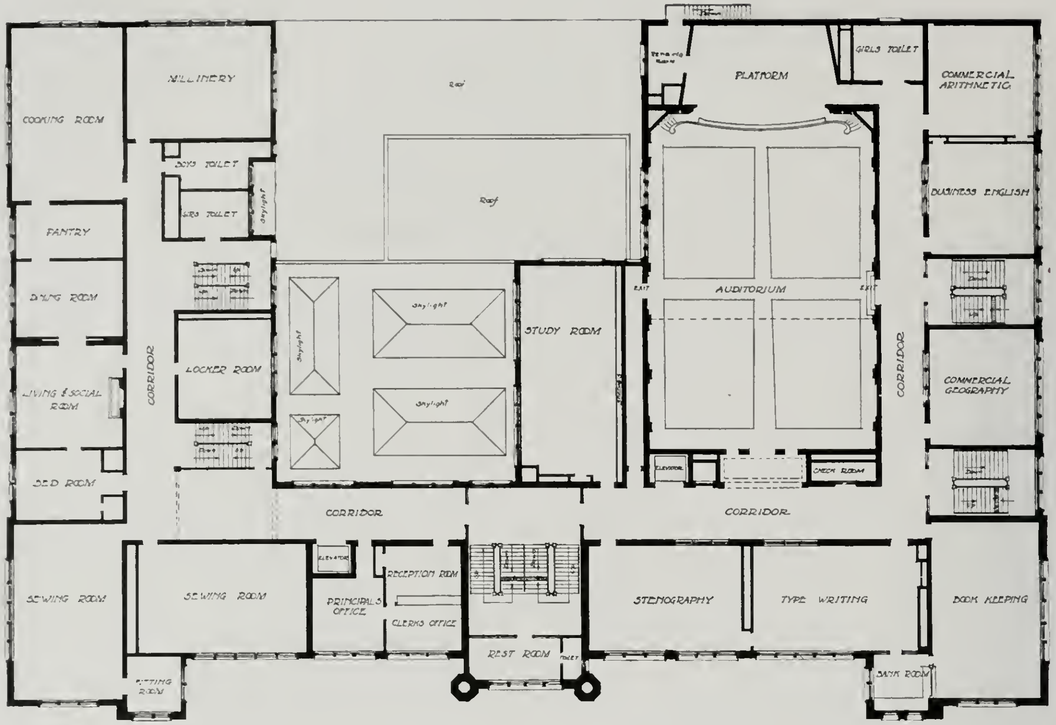


THIRD FLOOR PLAN, STIVERS HIGH SCHOOL, DAYTON, O.

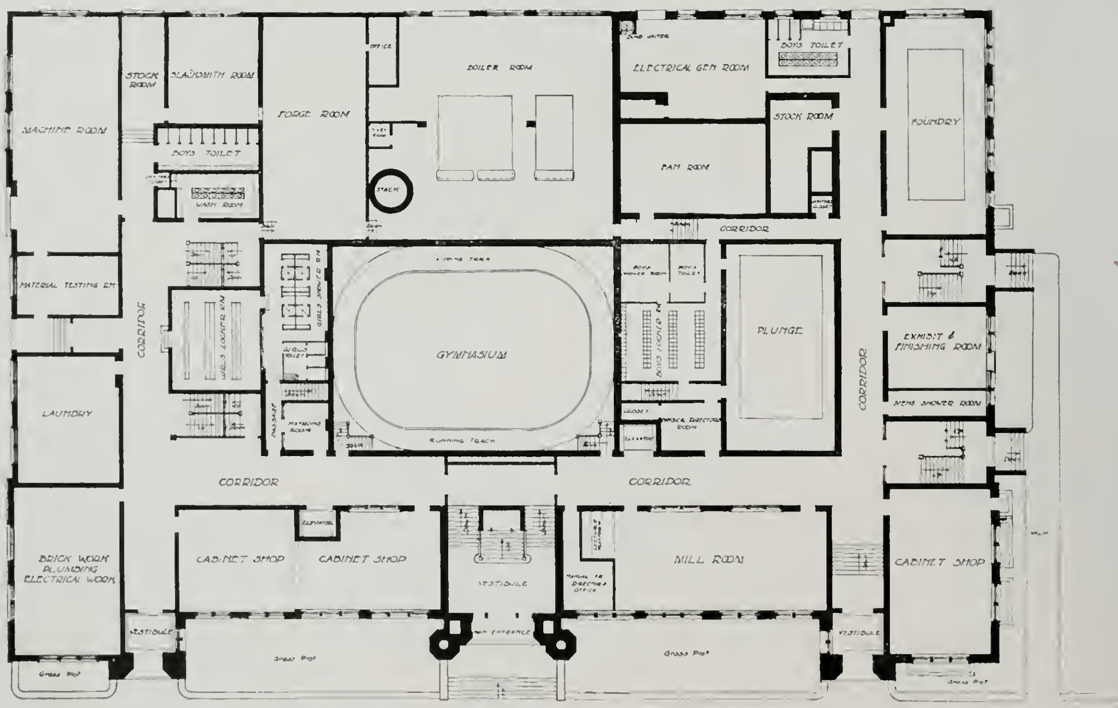


SECOND FLOOR PLAN, STIVERS HIGH SCHOOL, DAYTON, O.

E. J. Mounstephen, Architect, Dayton, O.



FIRST FLOOR PLAN, STIVERS HIGH SCHOOL, DAYTON, O.

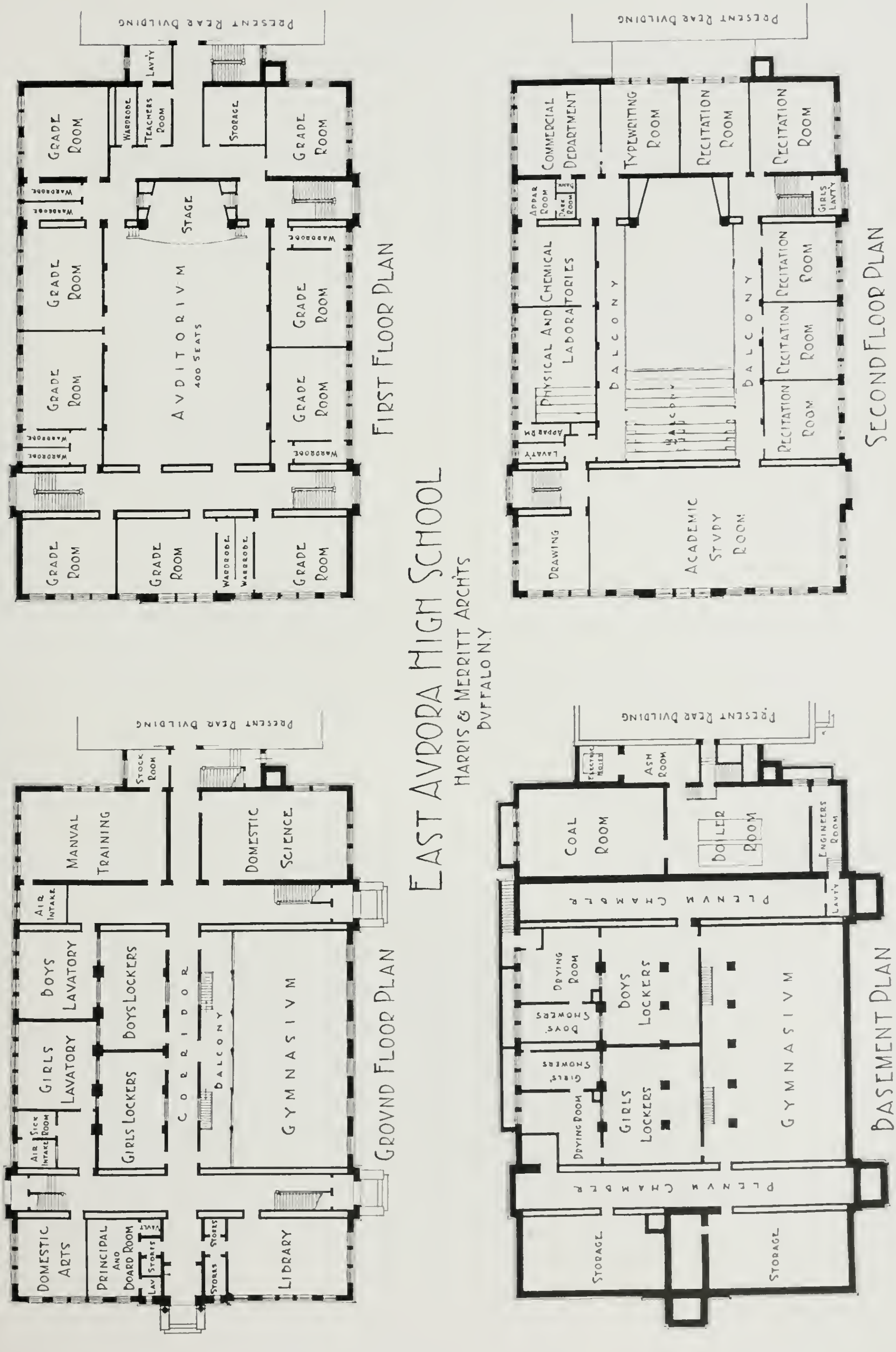


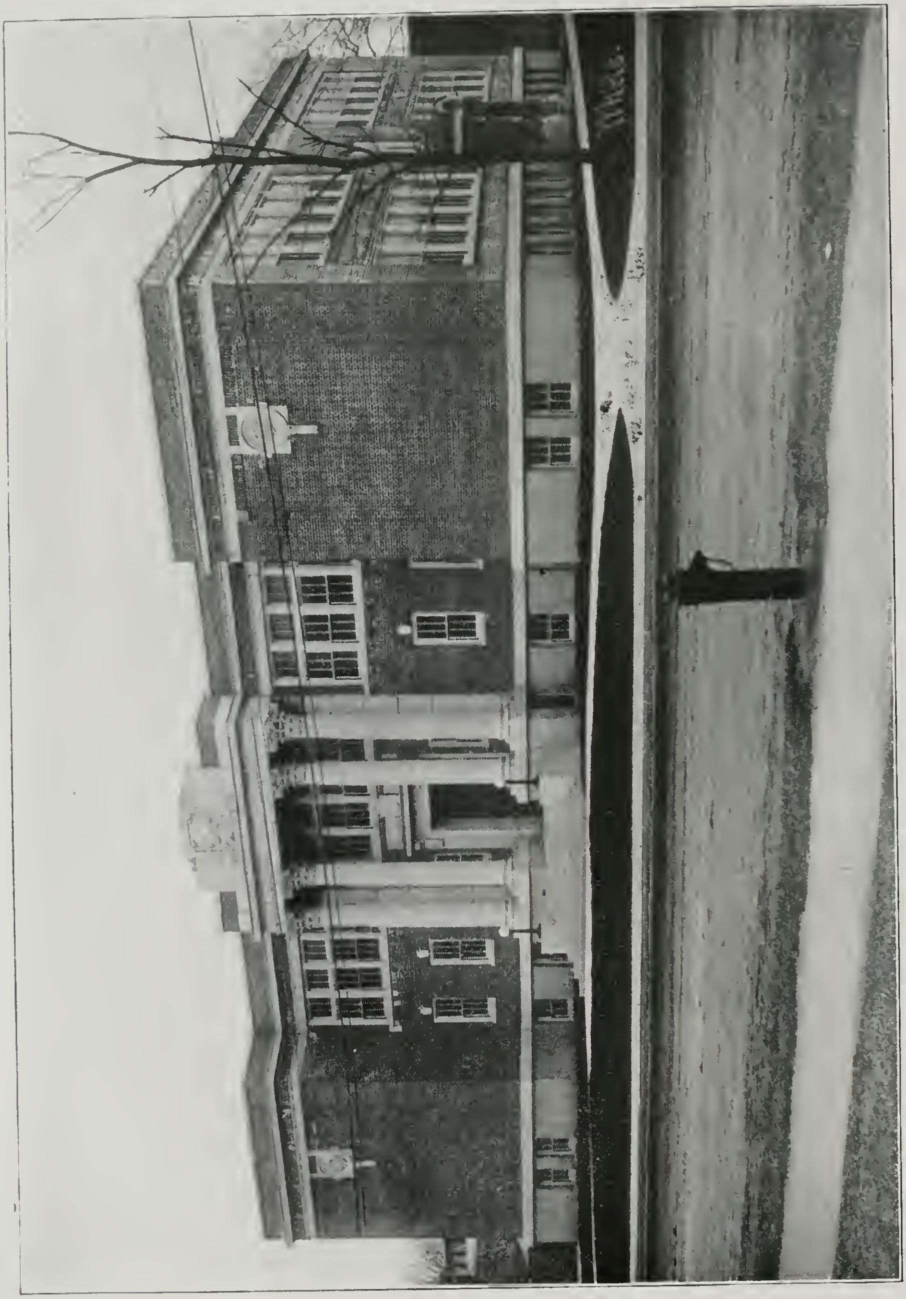
GROUND FLOOR PLAN, STIVERS HIGH SCHOOL, DAYTON, O.

E. J. Mounstephen, Architect, Dayton, O.

AUDITORIUM, HIGH SCHOOL, EAST AURORA, N. Y. Harris & Merritt, Architects, Buffalo, N. Y.

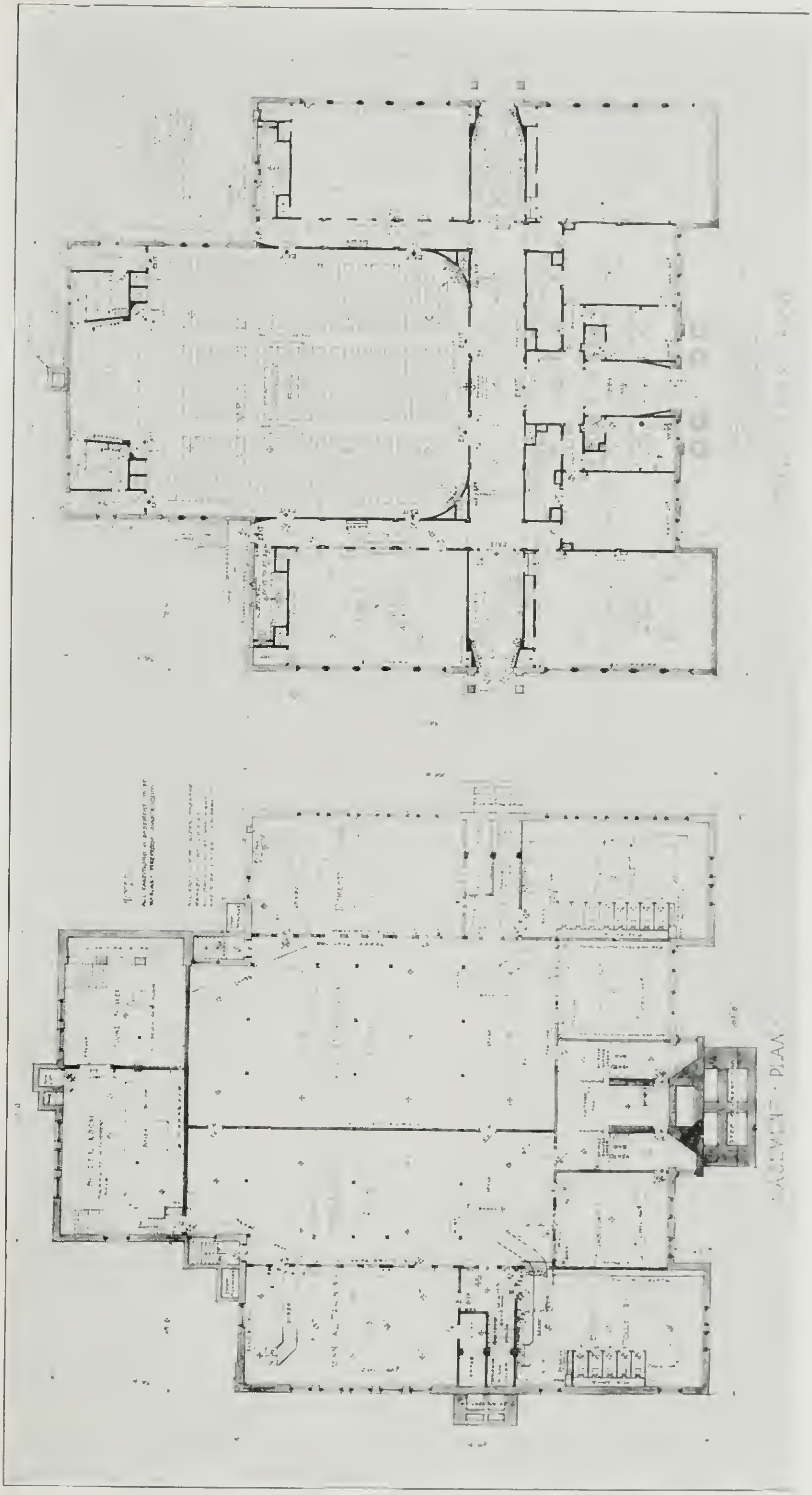
HIGH SCHOOL, EAST AURORA, N. Y. Harris & Merritt, Architects, Buffalo, N. Y.


East Aurora High School
Harris & Merritt Archts
Buffalo N.Y.
First Floor Plan
Second Floor Plan
Ground Floor Plan
Basement Plan
Present Rear Building
Grade Room
Auditorium 400 Seats
Stage
Wardrobe
Teachers Room
Lavty
Storage
Commercial Department
Typewriting Room
Recitation Room
Physical and Chemical Laboratories
Balcony
Academic Study Room
Drawing
Appar Room
Dark Room
Girls Lavty
Manual Training
Domestic Science
Air Intake
Boys Lavatory
Girls Lavatory
Sick Room
Boys Lockers
Girls Lockers
Corridor
Gymnasium
Domestic Arts
Principal and Board Room
Stores
Lav
Library
Stock Room
Coal Room
Boiler Room
Ash Room
Engineers Room
Plenum Chamber
Drying Room
Boys Showers
Girls Showers
Storage



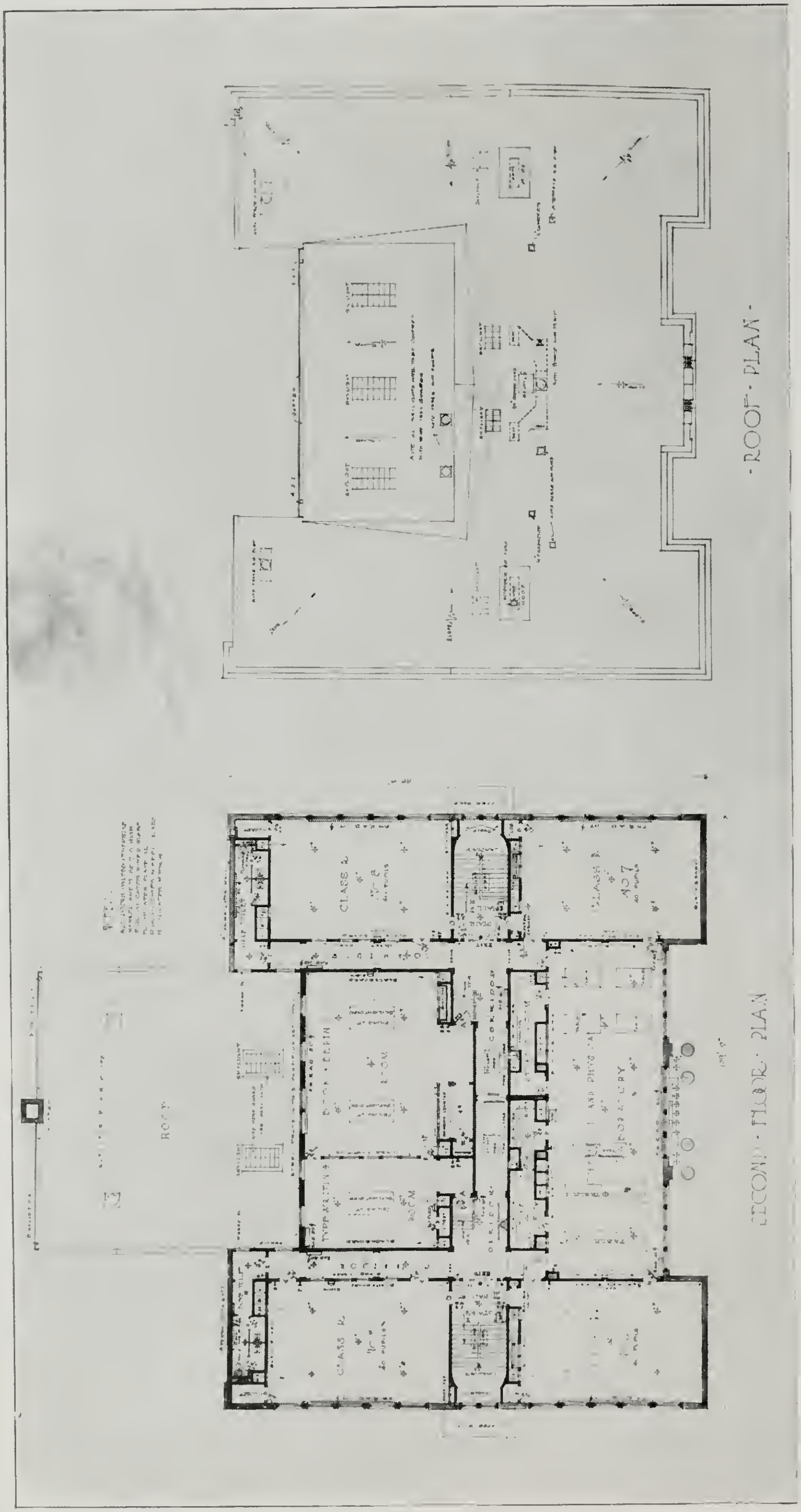
HIGH SCHOOL, BENNINGTON, VT.

Frank Irving Cooper, Architect, Boston, Mass.

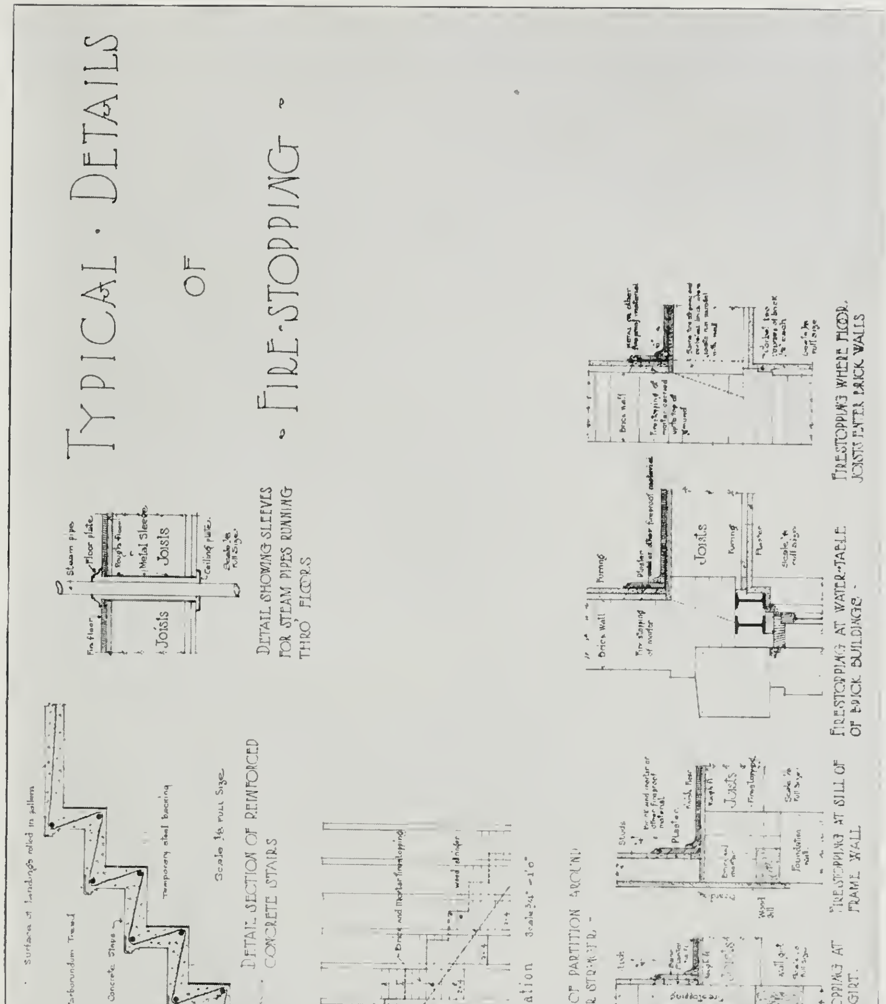


FLOOR PLANS OF HIGH SCHOOL, BENNINGTON, VT.

Frank Irving Cooper, Architect, Boston, Mass.

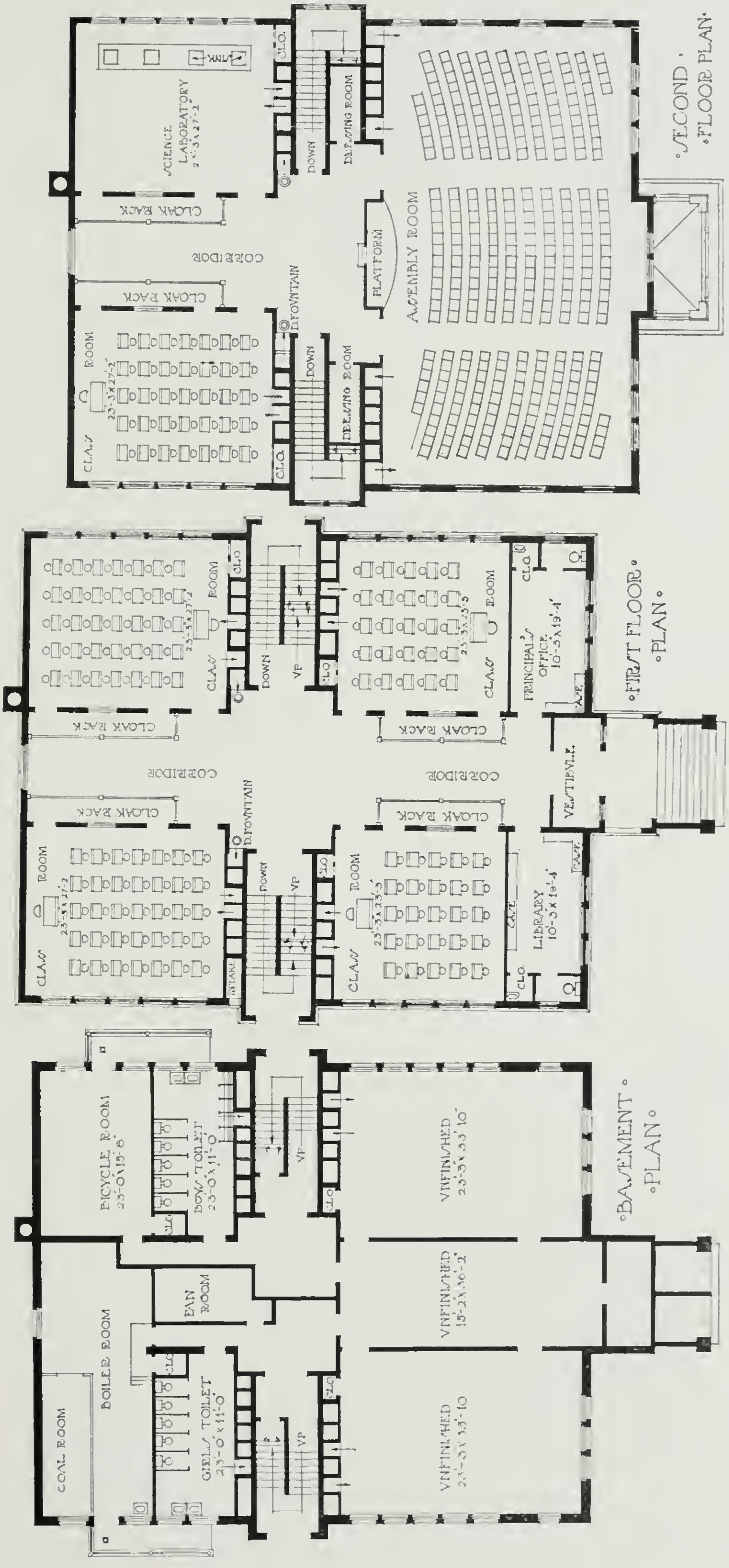


FLOOR PLANS, HIGH SCHOOL, BENNINGTON, VT.



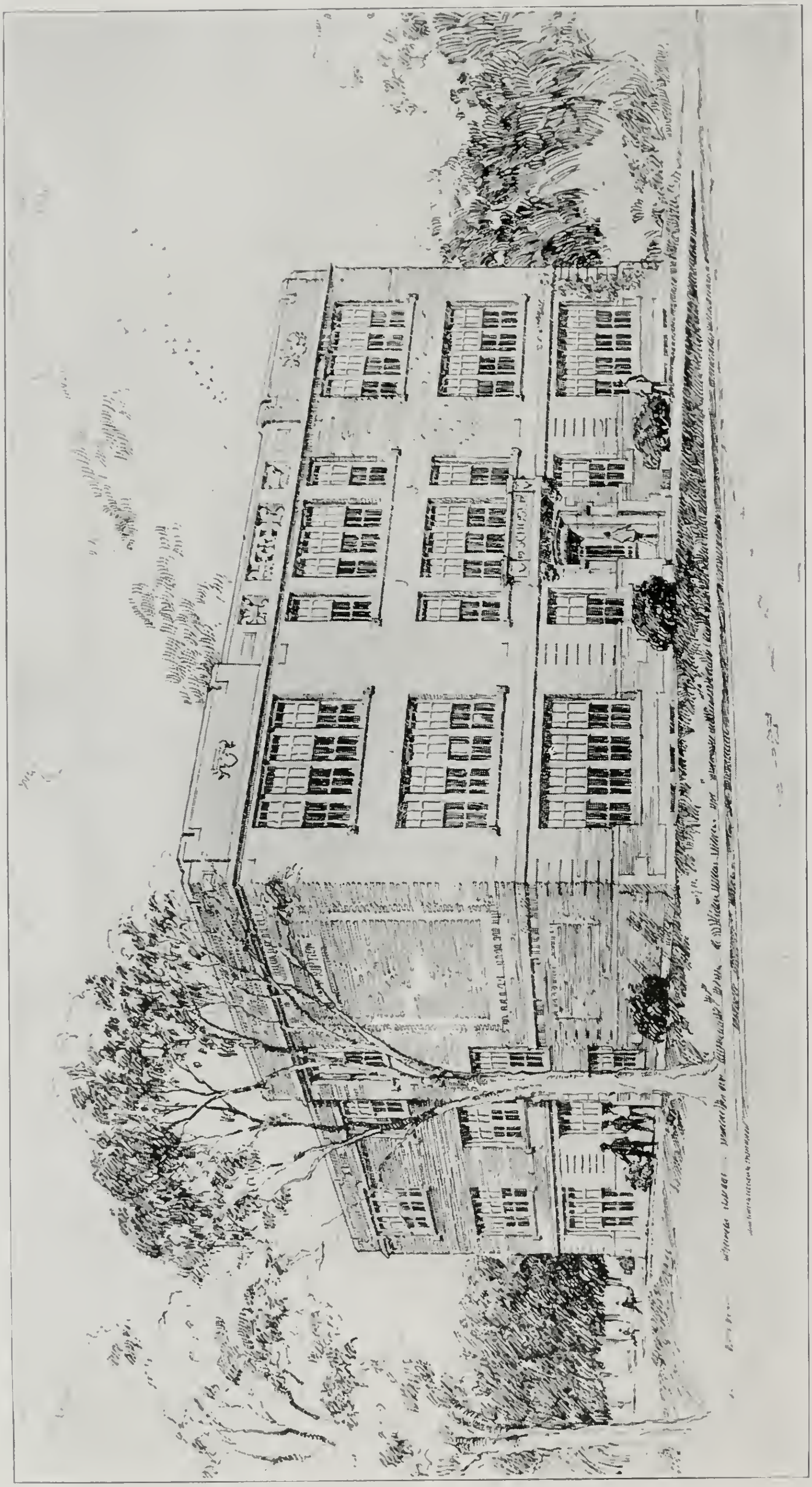
TYPICAL DETAILS OF FIRE STOPPING, HIGH SCHOOL, BENNINGTON, VT.

HIGH SCHOOL, MANASQUAN, N. J.
Clinton B. Cook, Architect, Asbury Park, N. J.



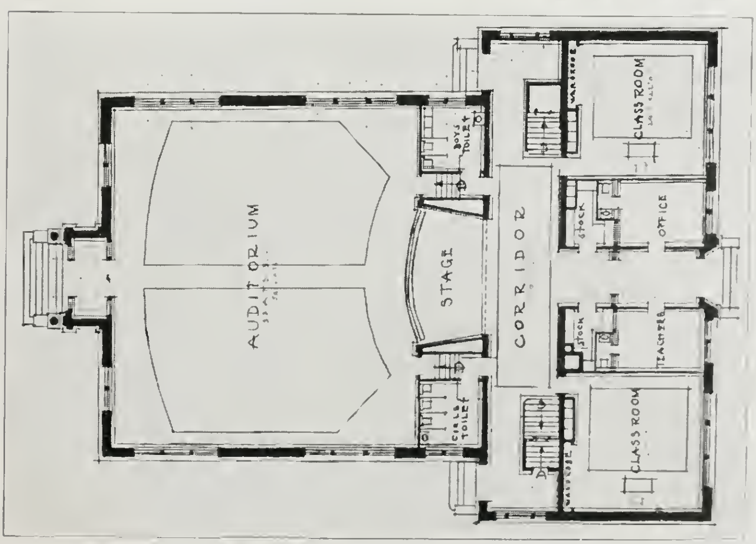
FLOOR PLANS, HIGH SCHOOL, MANASQUAN, N. J.

Clinton B. Cook, Architect, Asbury Park, N. J.

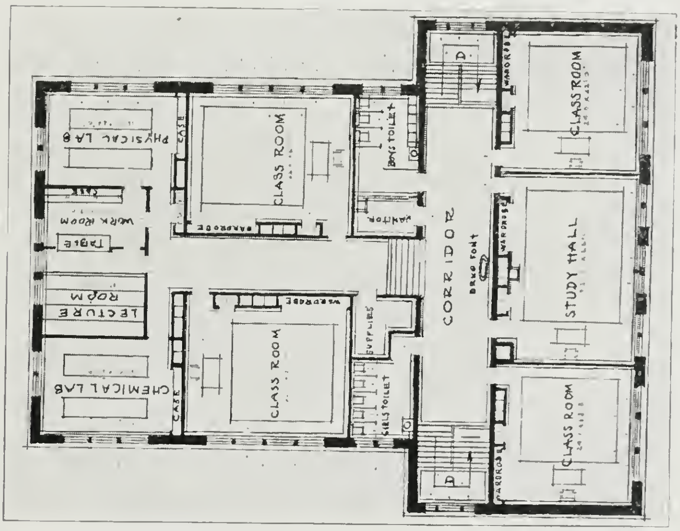


HIGH SCHOOL, SHARPSBURG, PA.

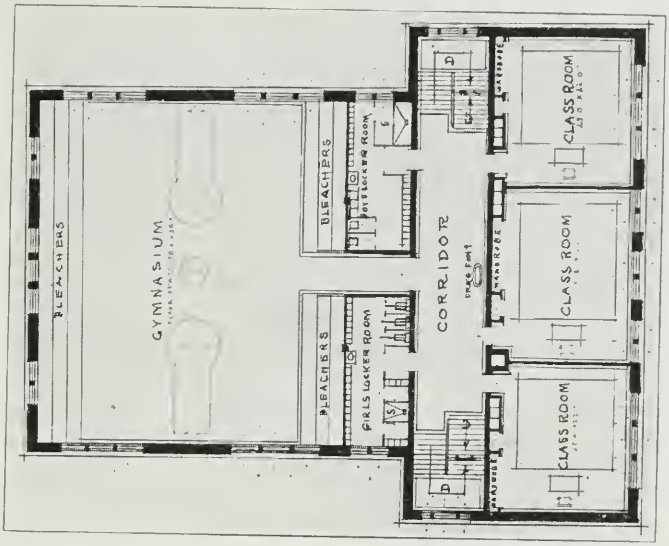
C. C. & A. L. Thayer, Architects, New Castle, Pa.



FIRST FLOOR PLAN.



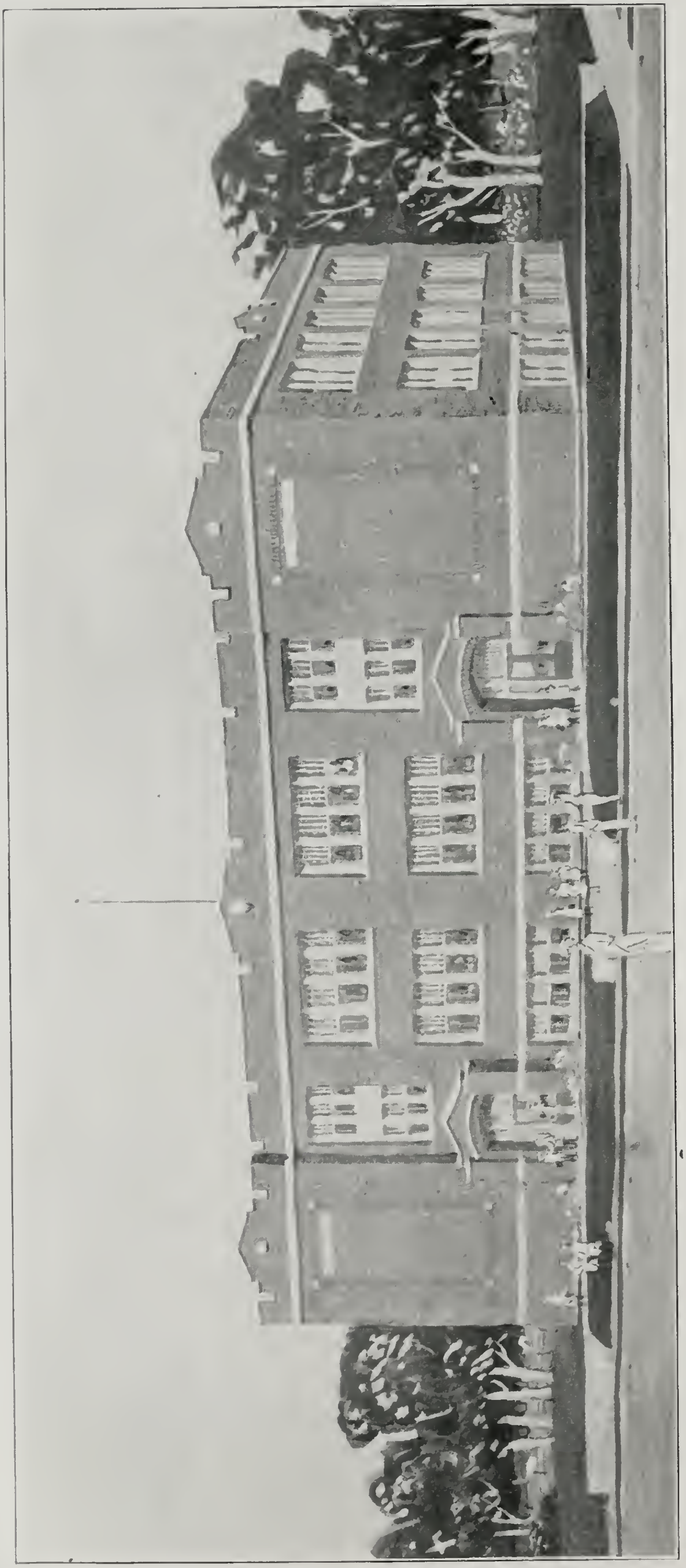
SECOND FLOOR PLAN.



THIRD FLOOR PLAN.

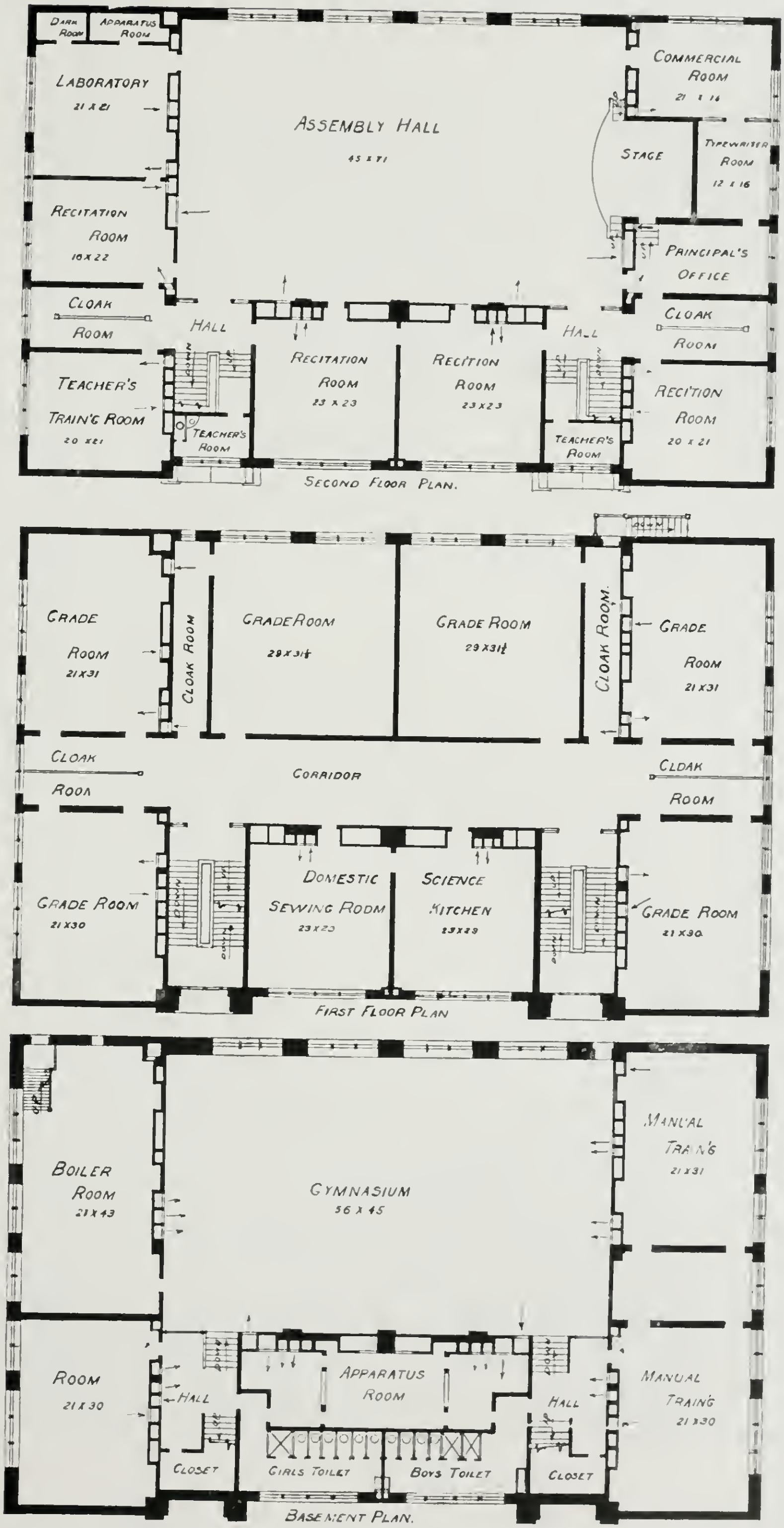
FLOOR PLANS, HIGH SCHOOL, SHARPSBURG, PA.

C. C. & A. L. Thayer, Architects, New Castle, Pa.

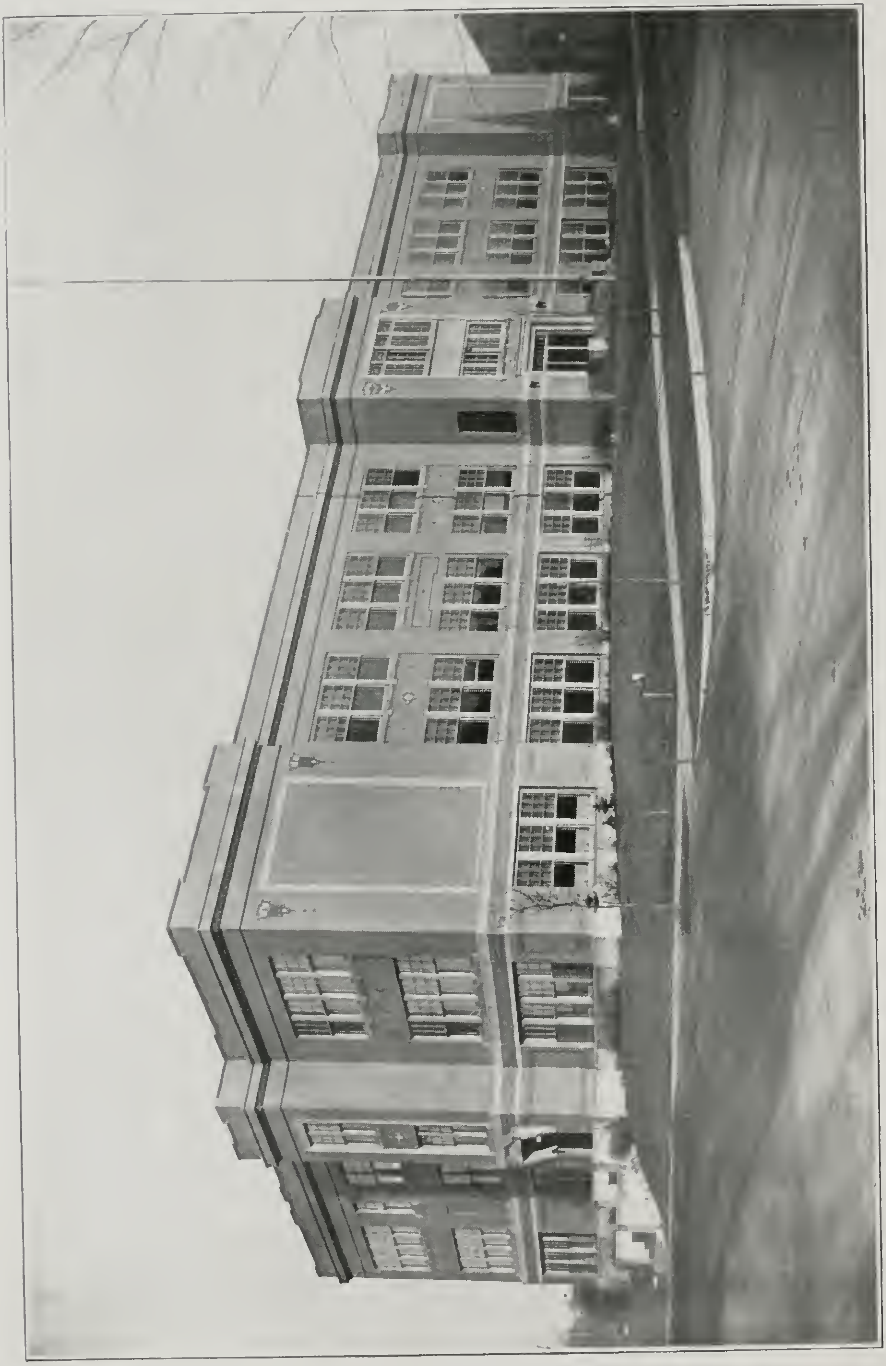


HIGH SCHOOL, ARCADIA, WIS.

Parkinson & Dockendorff, Architects, La Crosse, Wis.



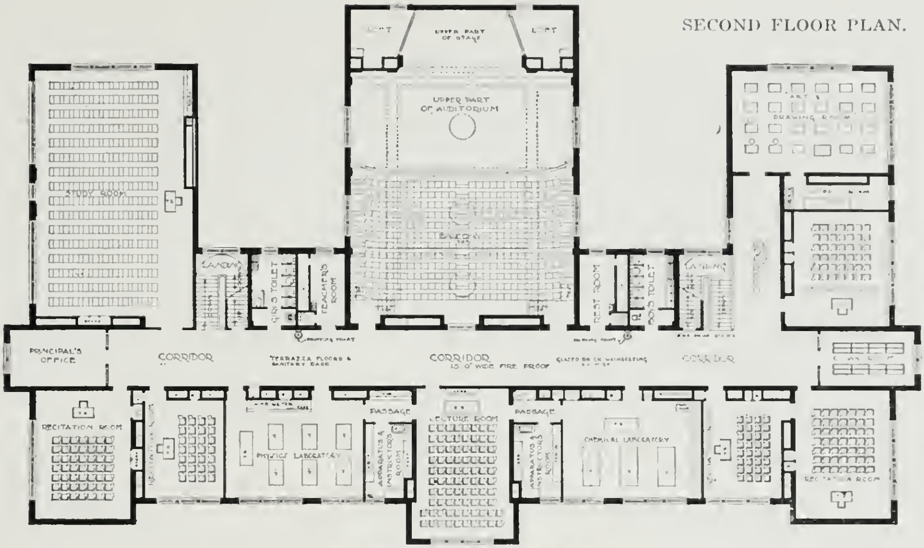
FLOOR PLANS, HIGH SCHOOL, ARCADIA, WIS.
Parkinson & Dockendorff, Architects, La Crosse, Wis.



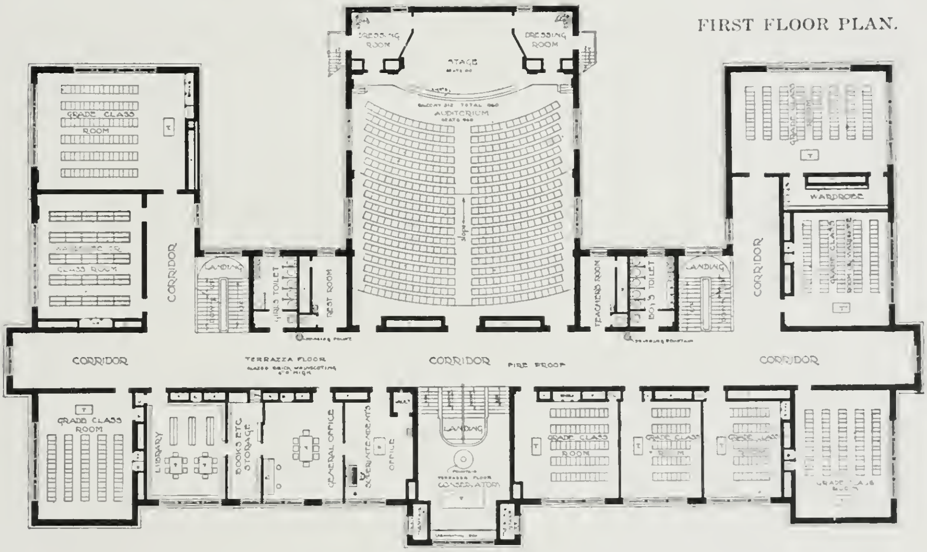
HIGH SCHOOL, CROOKSTON, MINN.

Bert D. Keck, Architect, Crookston, Minn.

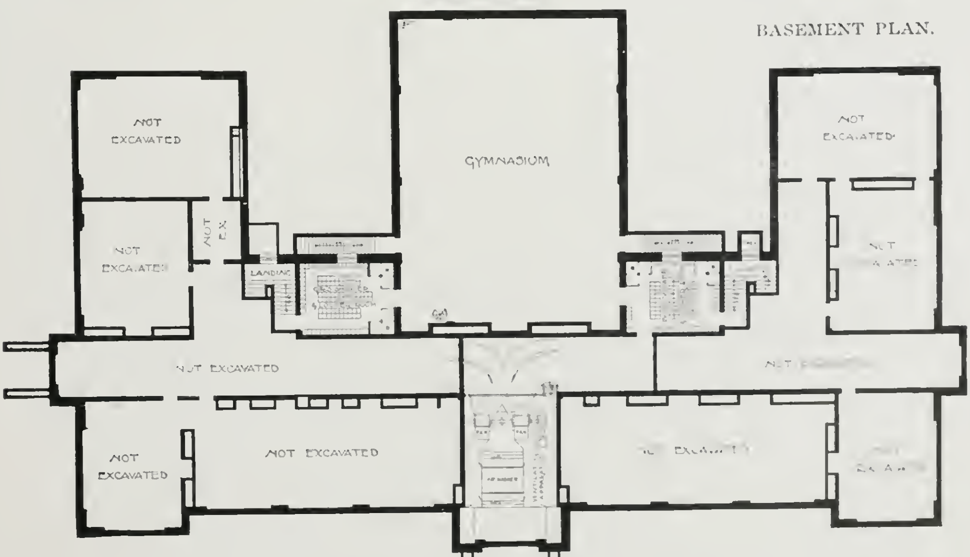
SECOND FLOOR PLAN.



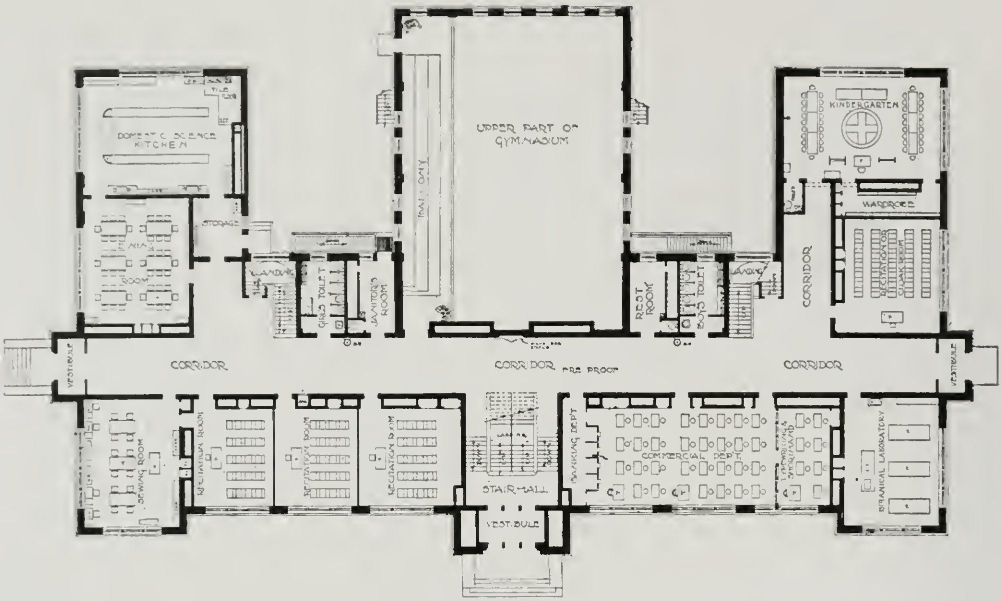
FIRST FLOOR PLAN.



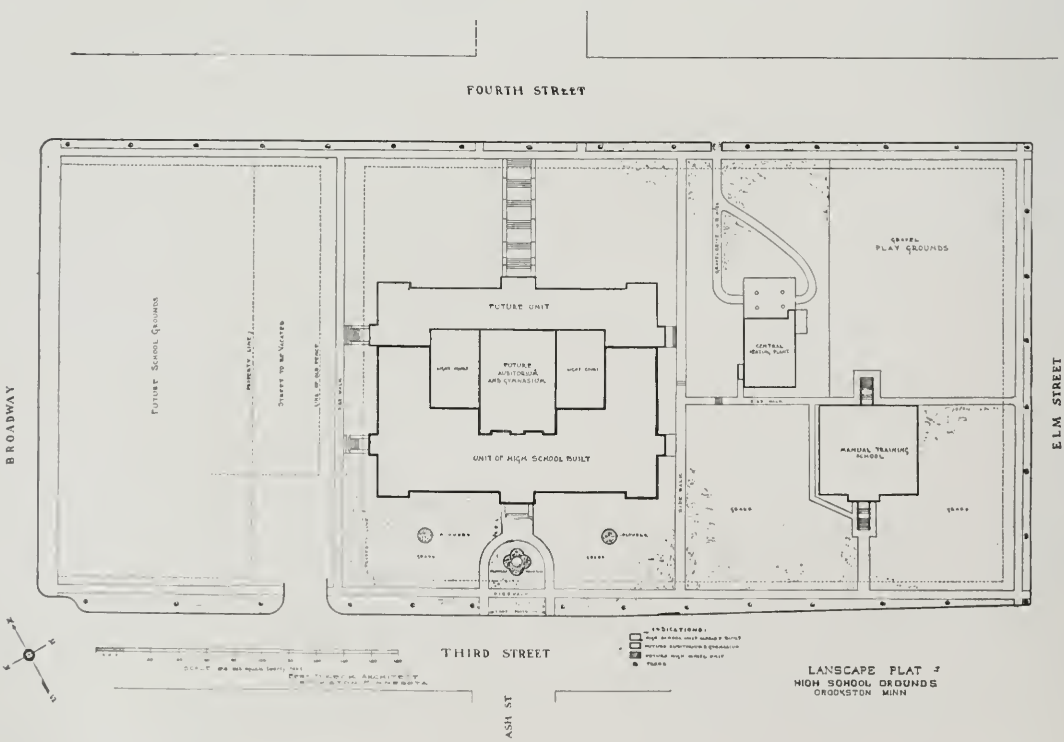
BASEMENT PLAN.



FLOOR PLANS, HIGH SCHOOL, CROOKSTON, MINN.



GROUND FLOOR PLAN, HIGH SCHOOL, CROOKSTON, MINN.

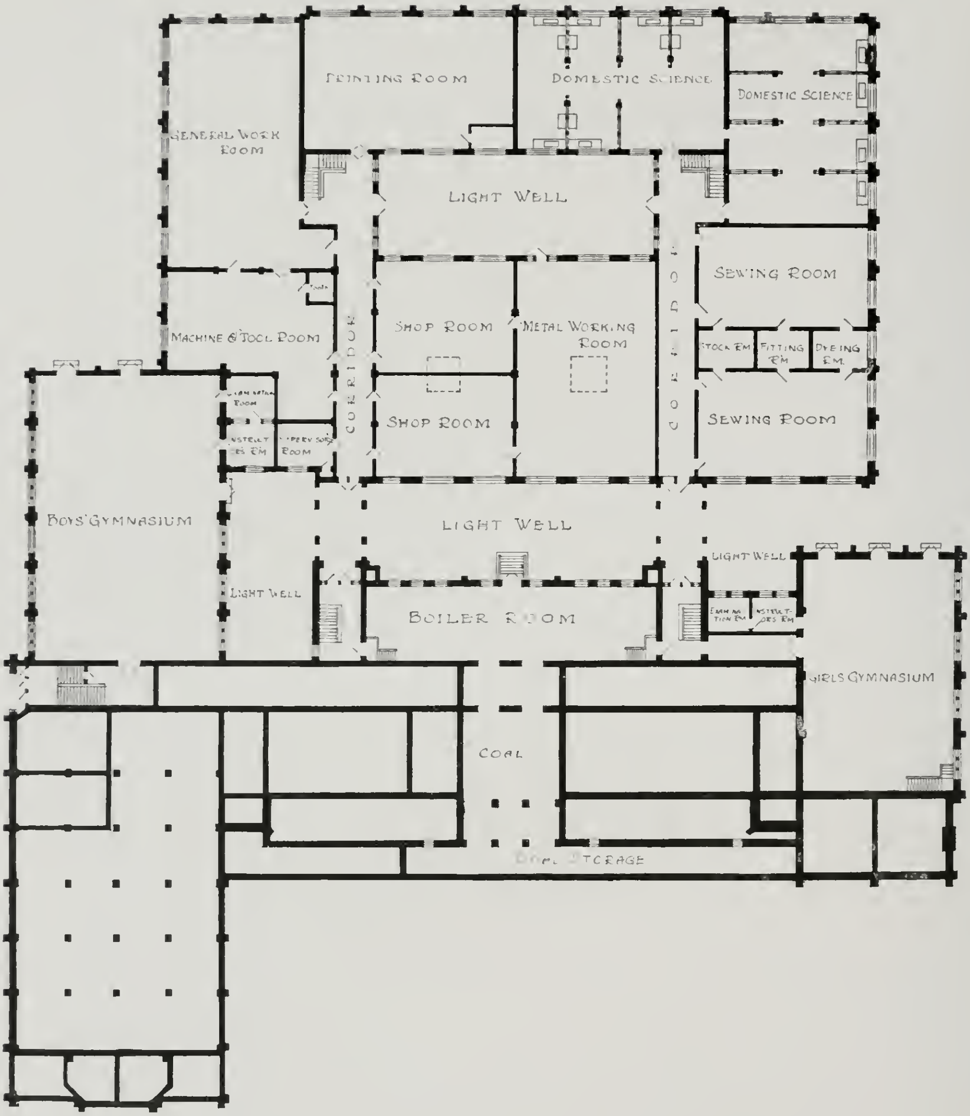


PLAT PLAN OF HIGH SCHOOL GROUP, CROOKSTON, MINN.

Bert D. Keck, Architect, Crookston, Minn.

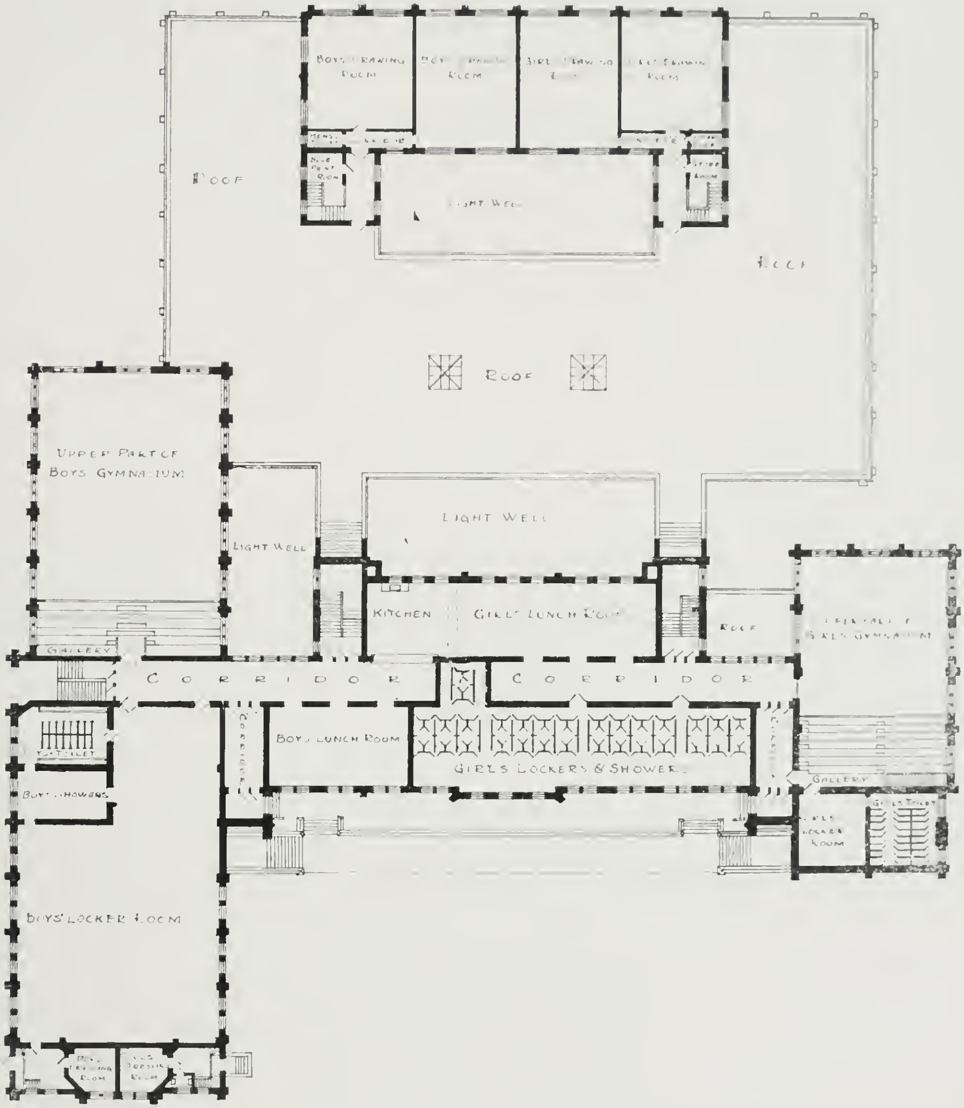
JUNIOR HIGH SCHOOL. TRENTON, N. J.

W. A. Poland, Architect, Trenton.

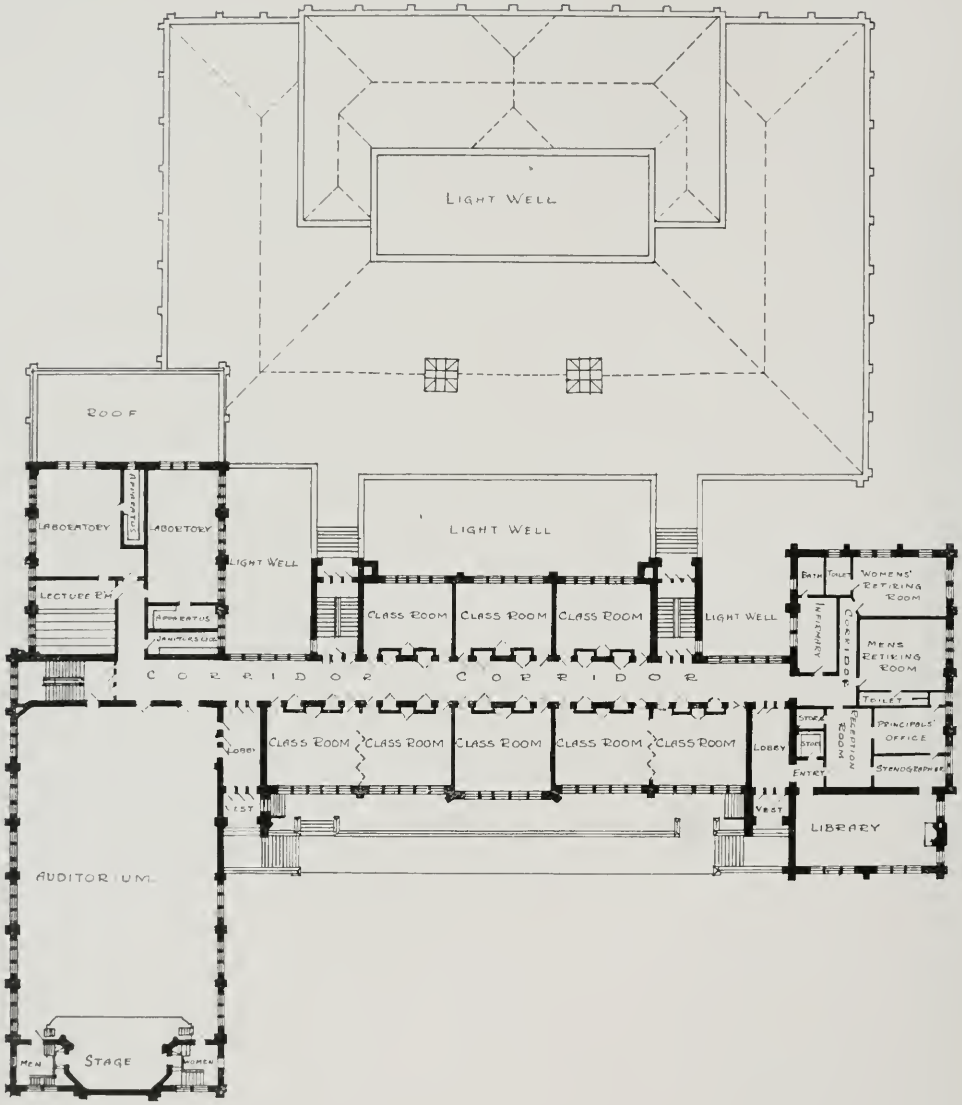


SUB-BASEMENT PLAN, JUNIOR HIGH SCHOOL, TRENTON, N. J.

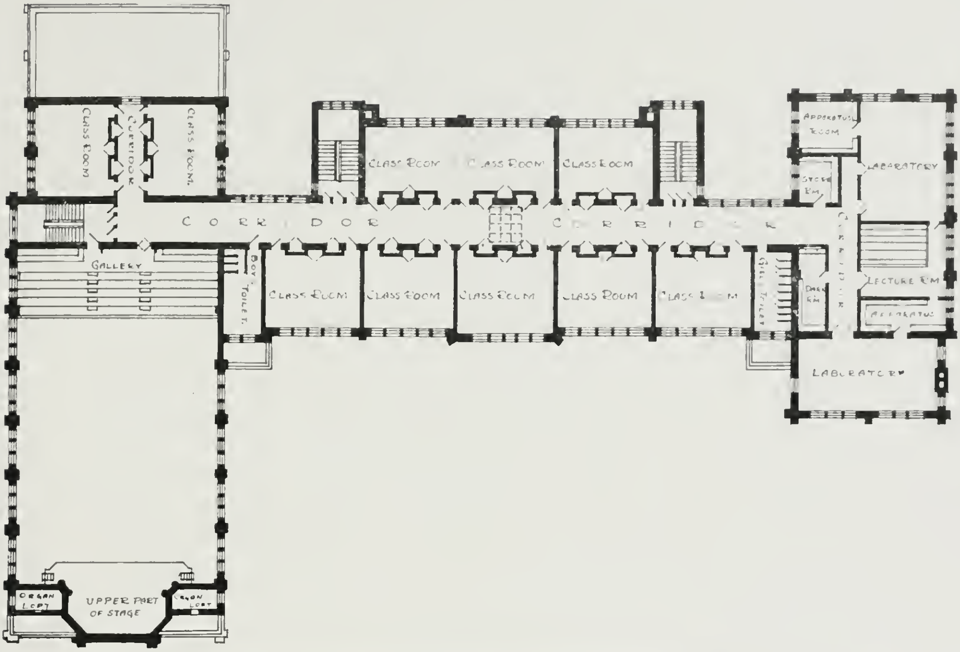
W. A. Poland, Architect, Trenton.



BASEMENT FLOOR PLAN, JUNIOR HIGH SCHOOL, TRENTON, N. J.
W. A. Poland, Architect, Trenton.

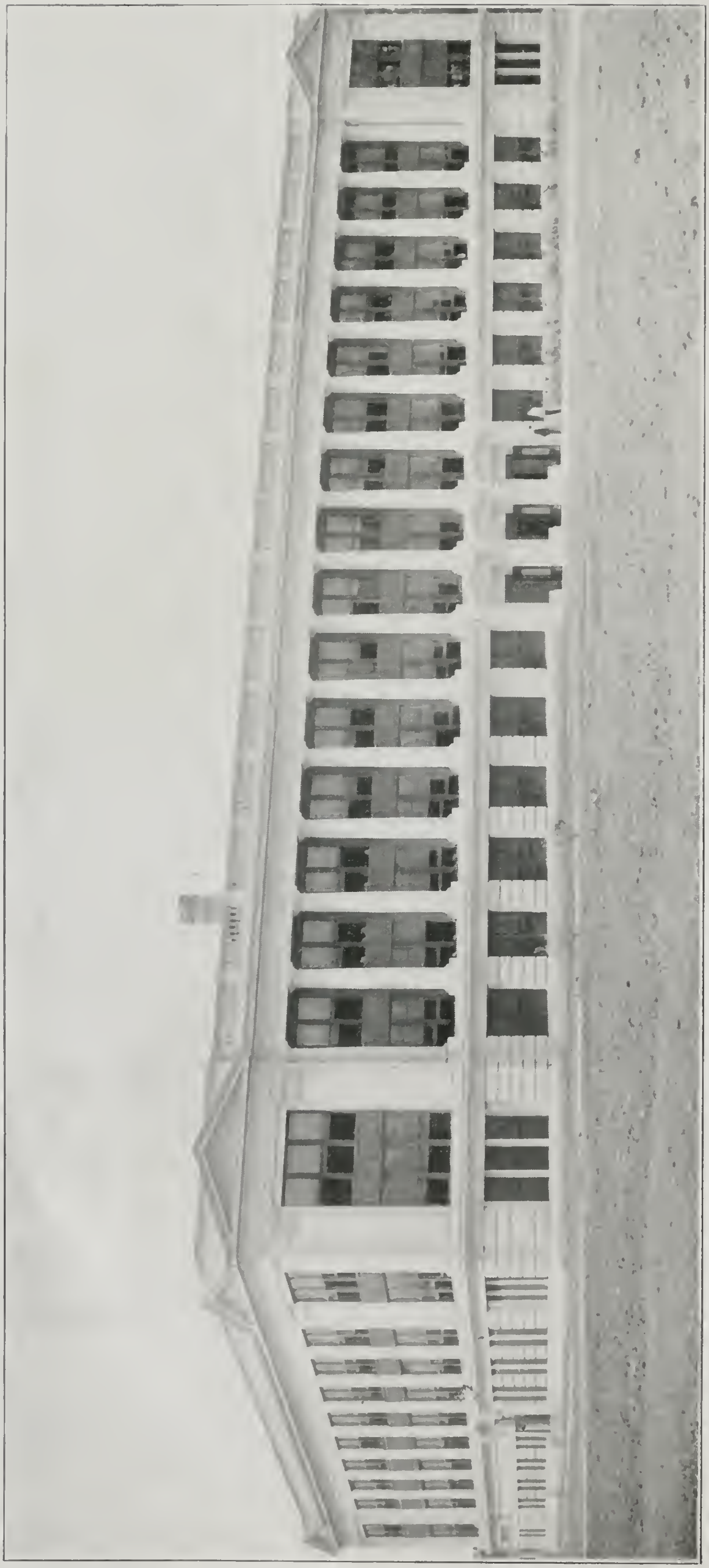


FIRST FLOOR PLAN, JUNIOR HIGH SCHOOL, TRENTON, N. J.
W. A. Poland, Architect, Trenton.

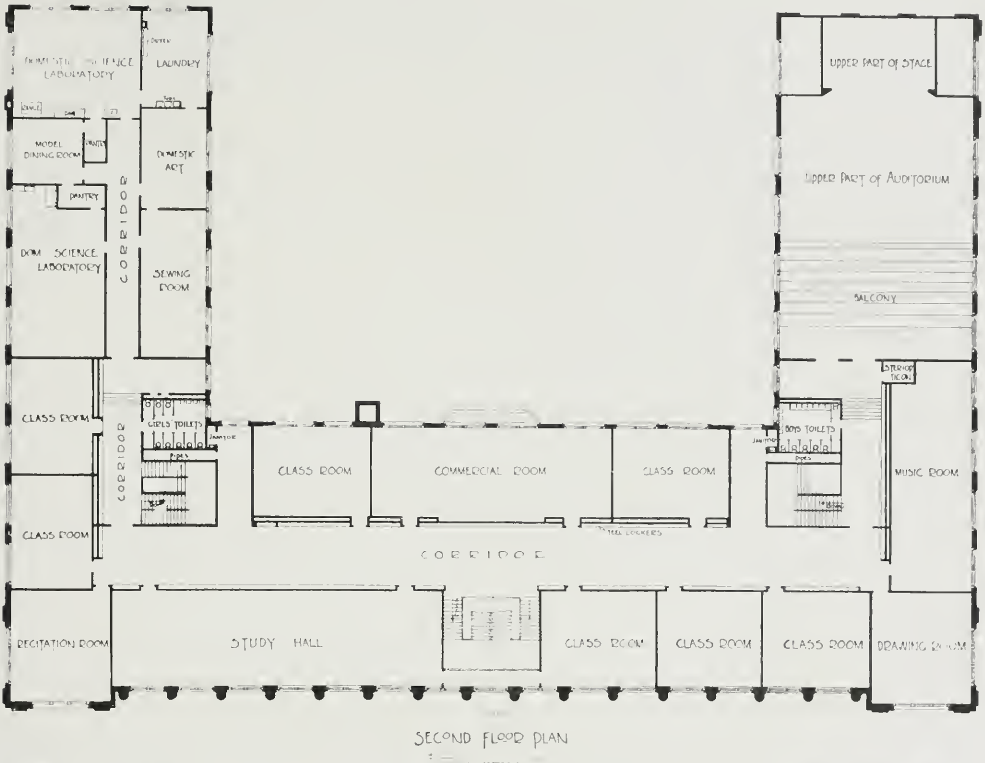


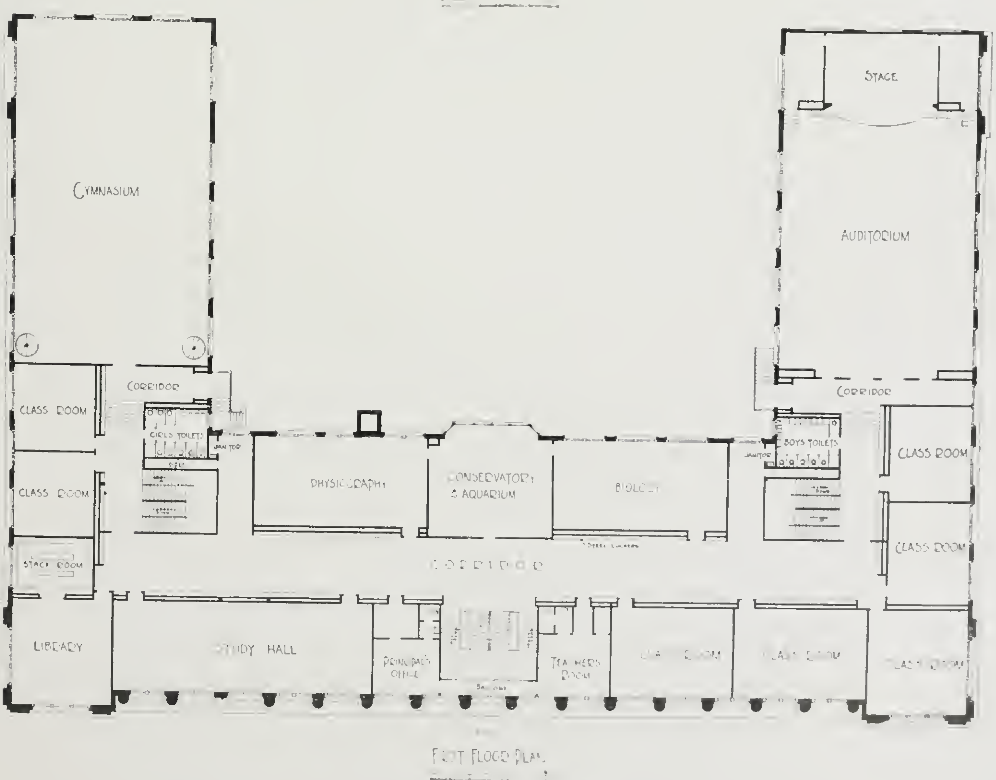
SECOND FLOOR PLAN, JUNIOR HIGH SCHOOL, TRENTON, N. J.

GYMNASIUM, JUNIOR HIGH SCHOOL, TRENTON, N. J.
W. A. Poland, Architect, Trenton.

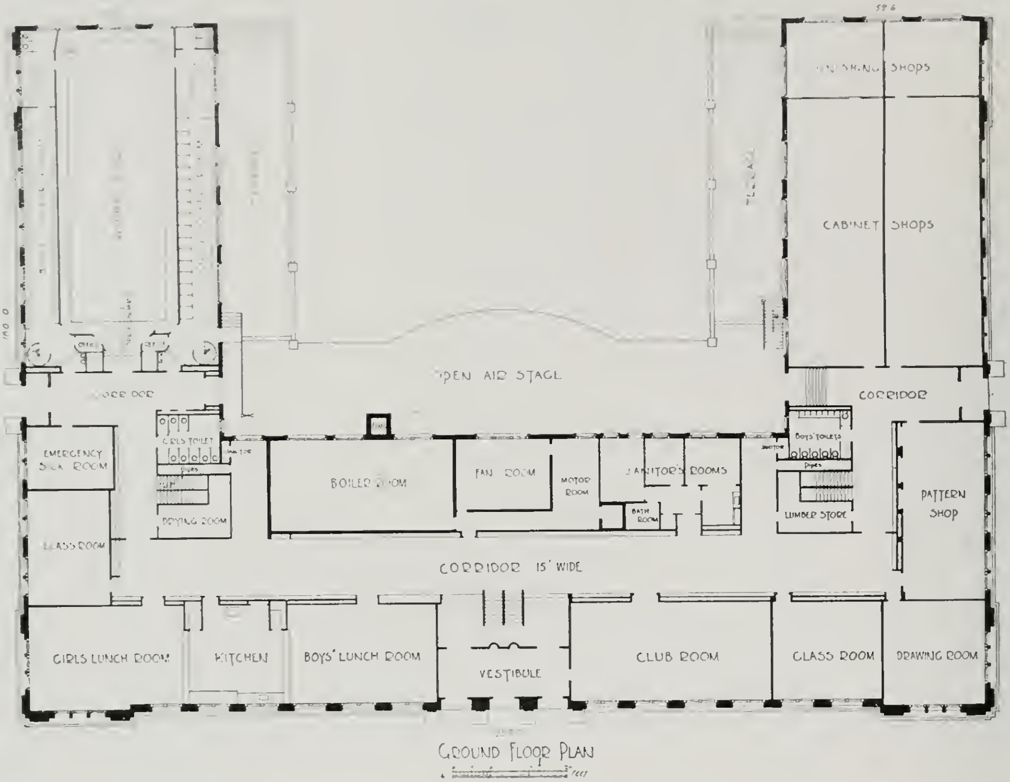


SOUTH END JUNIOR HIGH SCHOOL, HOUSTON, TEX.
Layton & Smith, Architects, Oklahoma City, Okla.



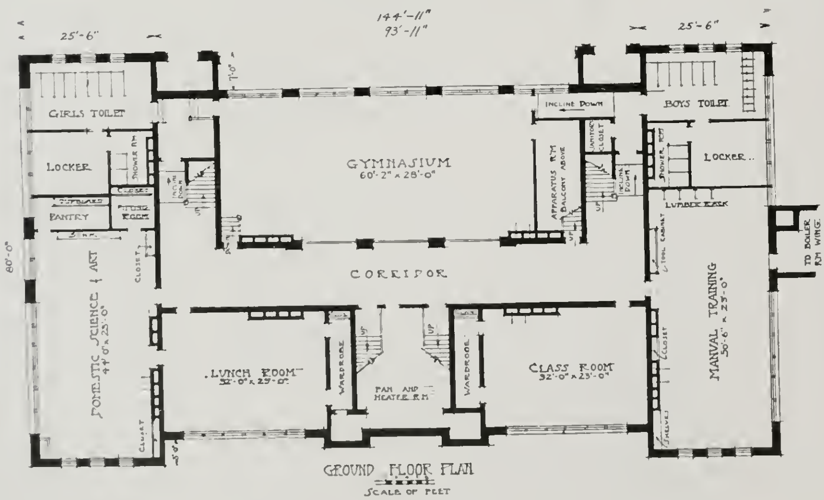


FLOOR PLANS, SOUTH END JUNIOR HIGH SCHOOL, HOUSTON, TEX.
Layton & Smith, Architects, Oklahoma City, Okla.



GROUND FLOOR PLAN, SOUTH END JUNIOR HIGH SCHOOL, HOUSTON, TEX.

Layton & Smith, Architects, Oklahoma City, Okla.

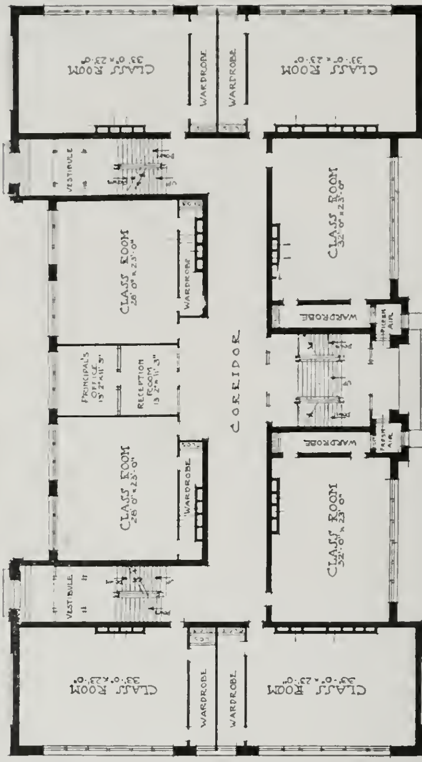


GROUND FLOOR PLAN, SHERMAN JUNIOR HIGH SCHOOL, HUTCHINSON, KANS.

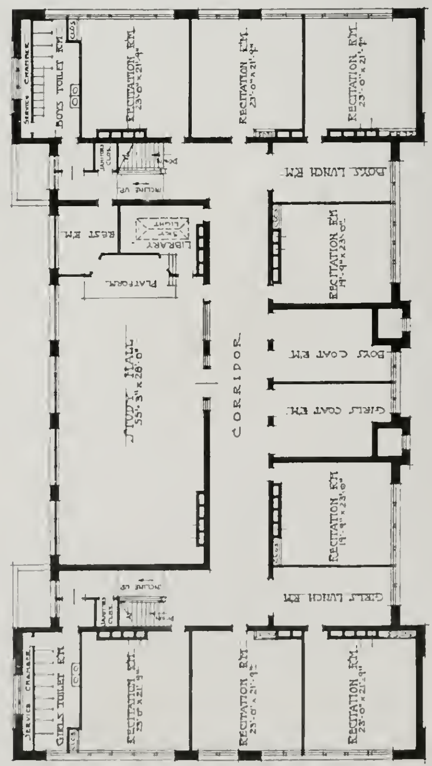
Mann & Gerow, Architects, Hutchinson.

SHERMAN JUNIOR HIGH SCHOOL, HUTCHINSON, KANS.

Mann & Gerow, Architects, Hutchinson.



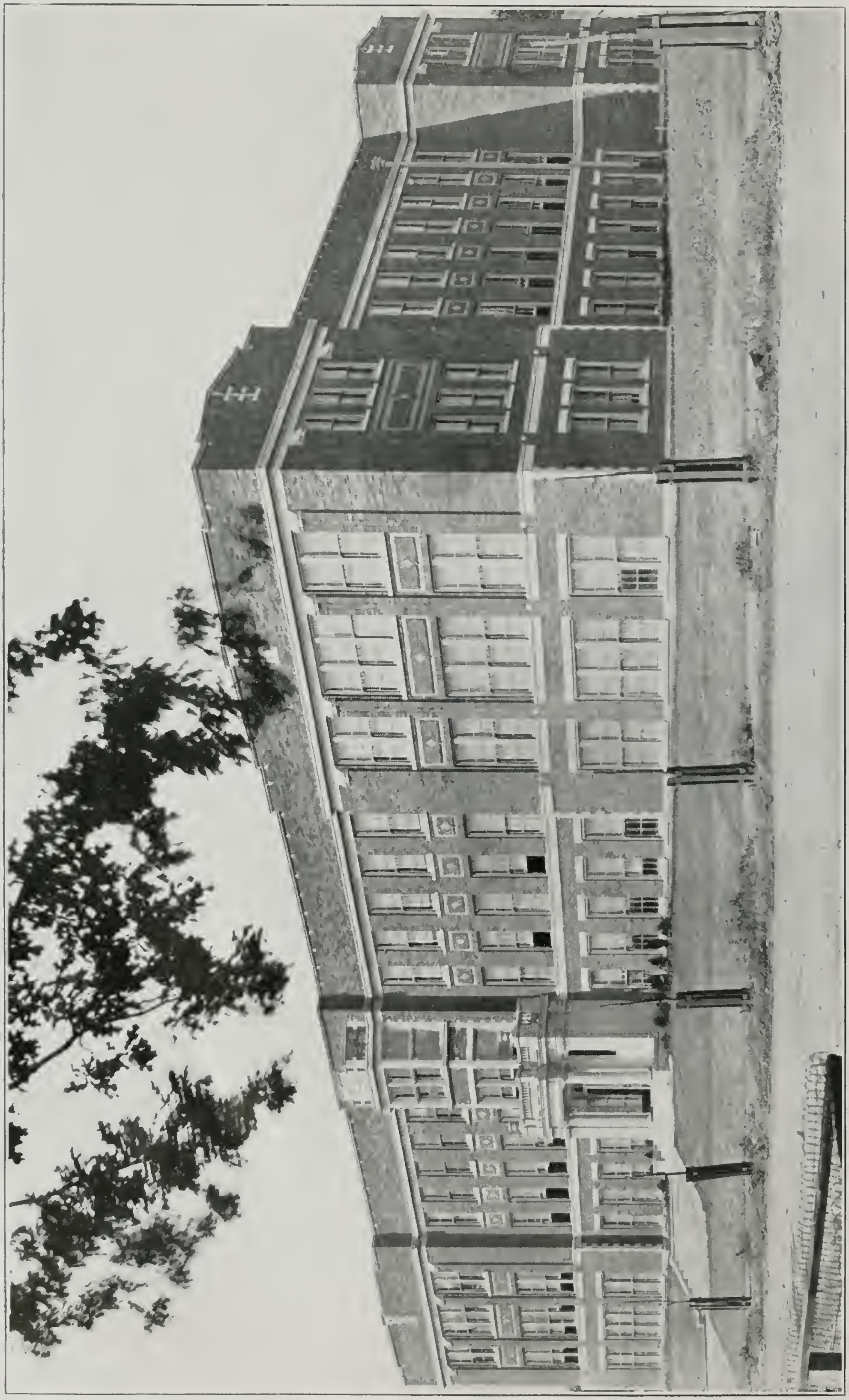
FIRST FLOOR PLAN
SCALE OF FEET



SECOND FLOOR PLAN
SCALE OF FEET

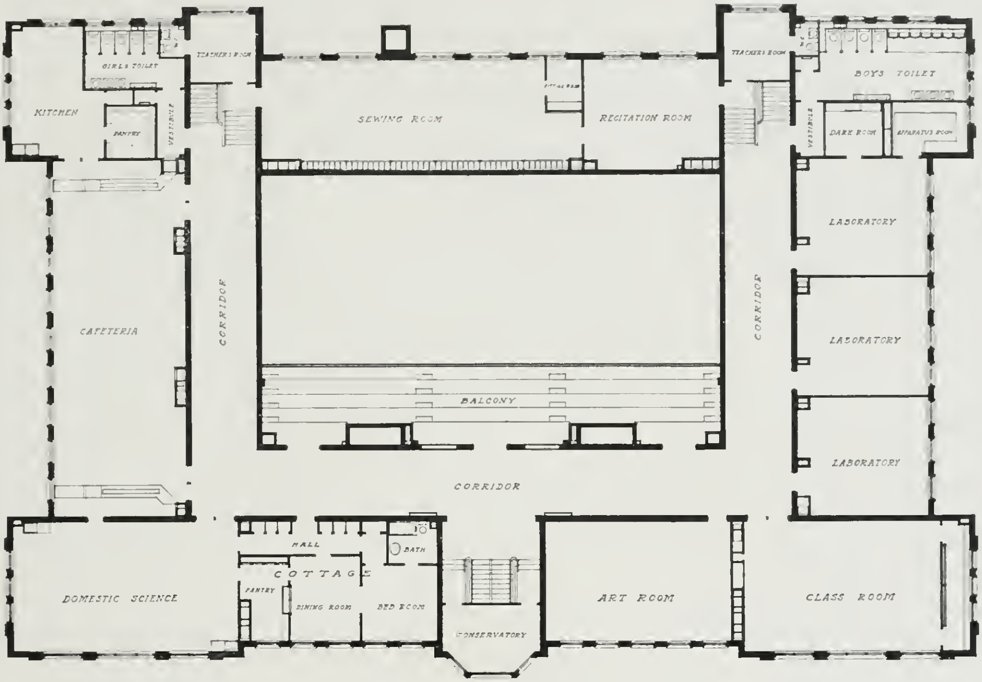
REAR ELEVATION AND FLOOR PLANS, SHERMAN JUNIOR HIGH SCHOOL BUILDING, HUTCHINSON, KANS.

DETAIL OF MAIN ENTRANCE, WEST SIDE JUNIOR HIGH SCHOOL, LITTLE ROCK, ARK.

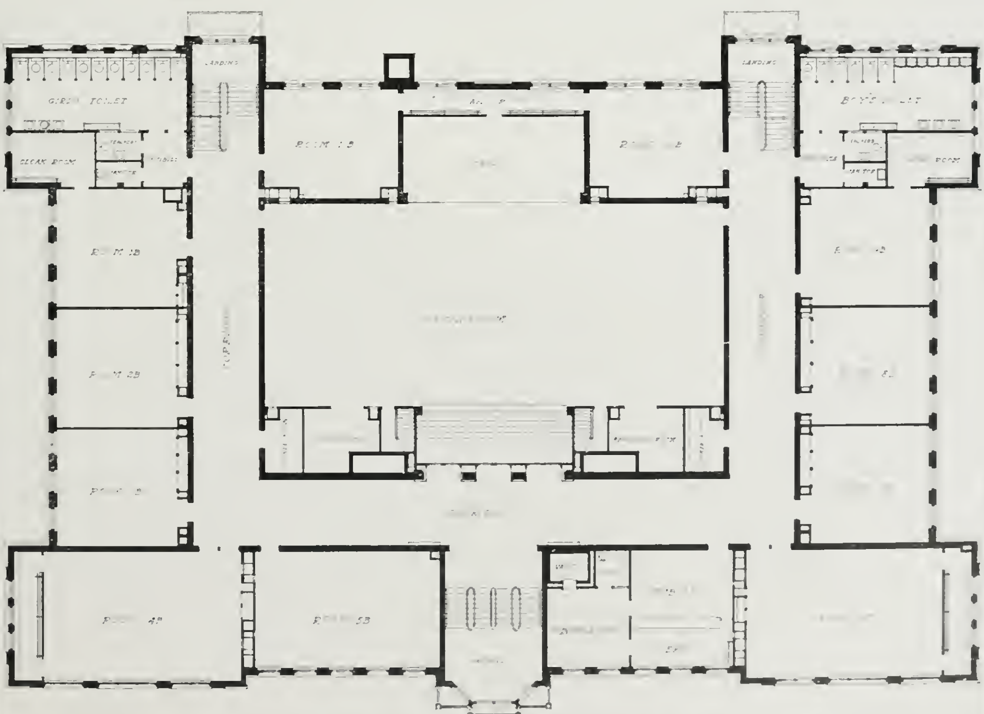


WEST SIDE JUNIOR HIGH SCHOOL, LITTLE ROCK, ARK.

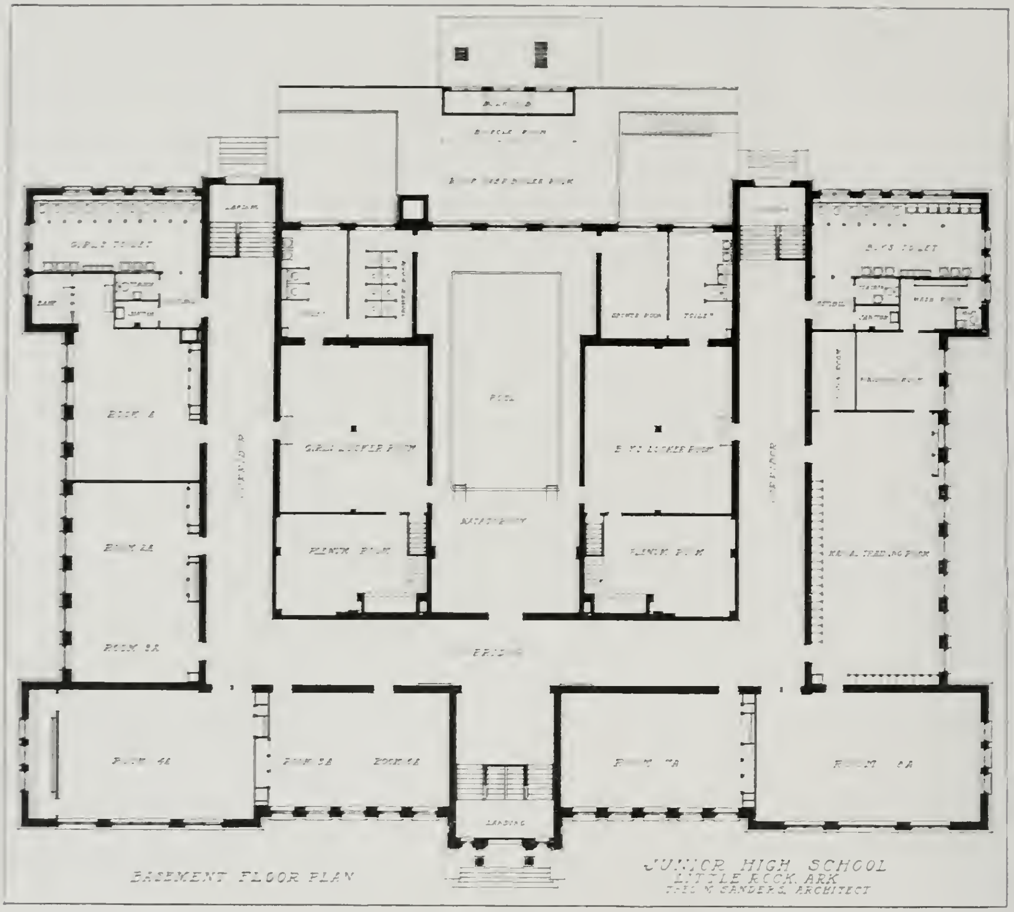
M. B. and Theo. Sanders, Architects, Little Rock.

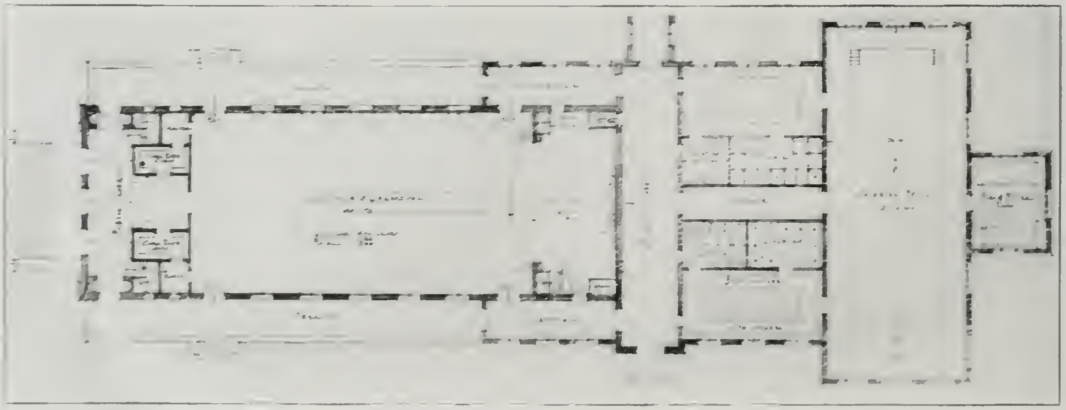


SECOND FLOOR PLAN
JUNIOR HIGH SCHOOL, LITTLE ROCK, ARK
THEO M. SANDERS, ARCHITECT



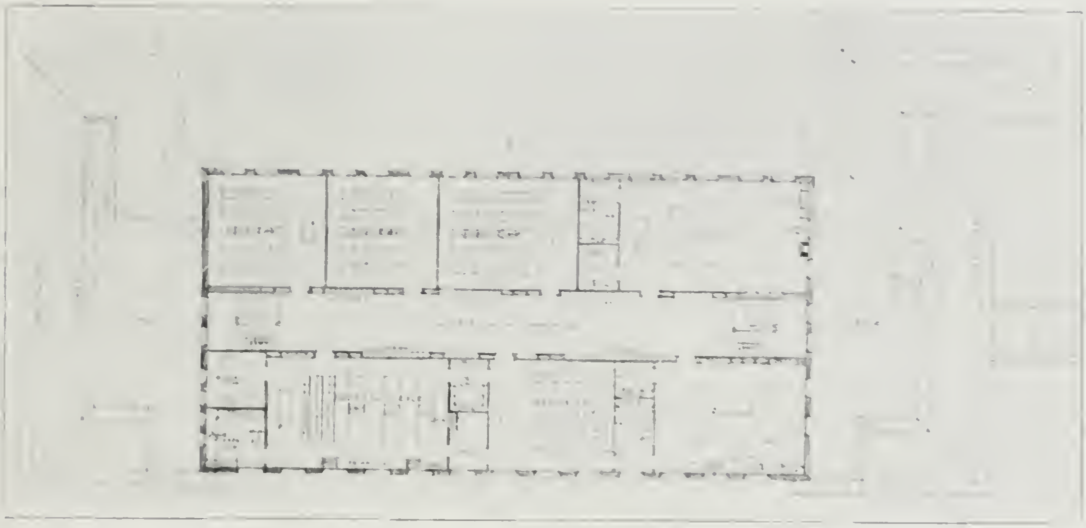
FIRST FLOOR PLAN
JUNIOR HIGH SCHOOL, LITTLE ROCK, ARK
THEO M. SANDERS, ARCHITECT



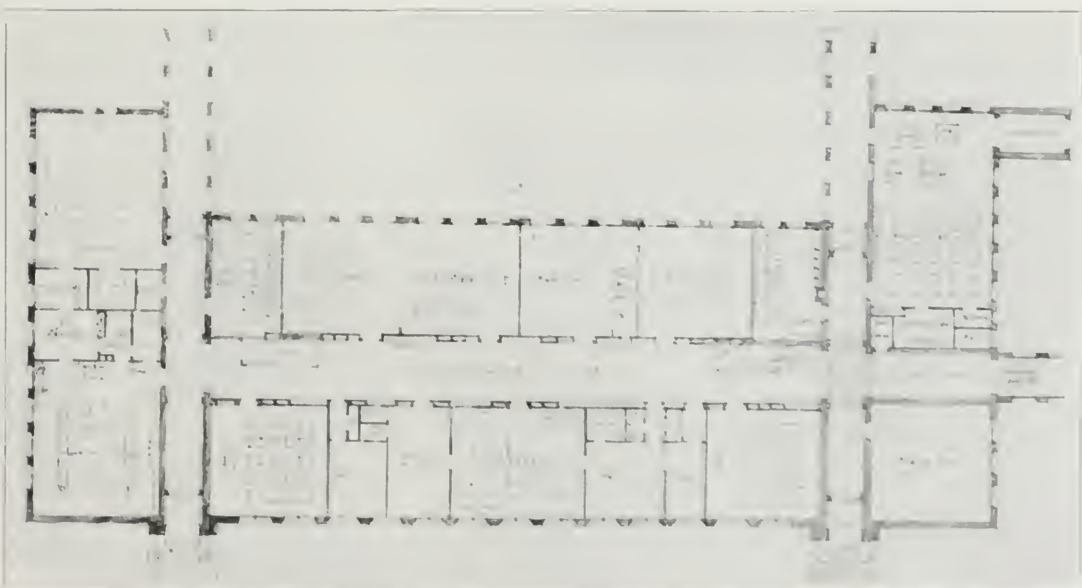


FLOOR PLAN OF GYMNASIUM AND AUDITORIUM BUILDING, ELKO COUNTY HIGH SCHOOL, ELKO, NEV.

J. J. Donovan, Architect, Oakland, Cal.

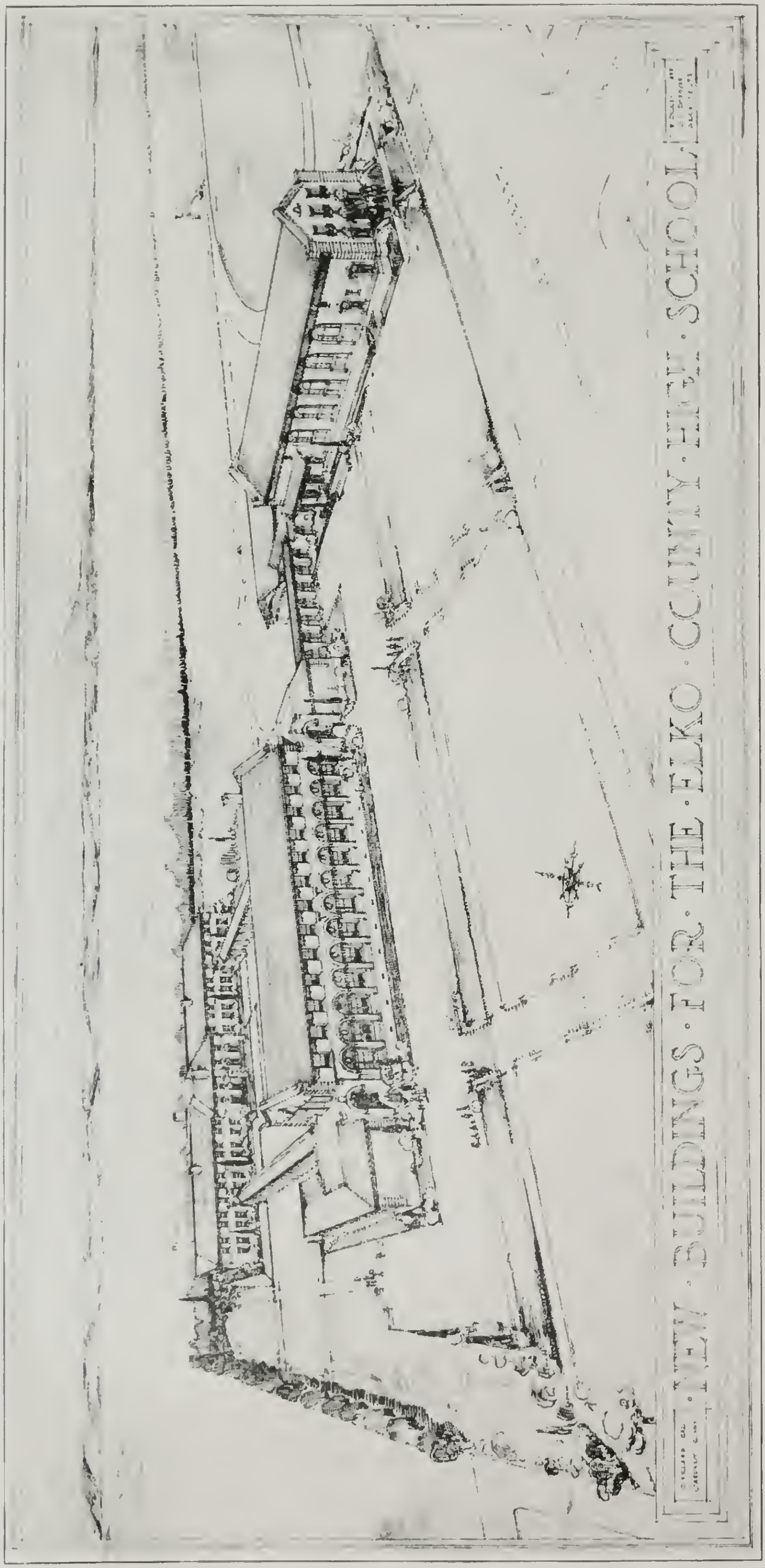


SECOND FLOOR PLAN, CLASSROOM BUILDING, ELKO COUNTY HIGH SCHOOL, ELKO, NEV



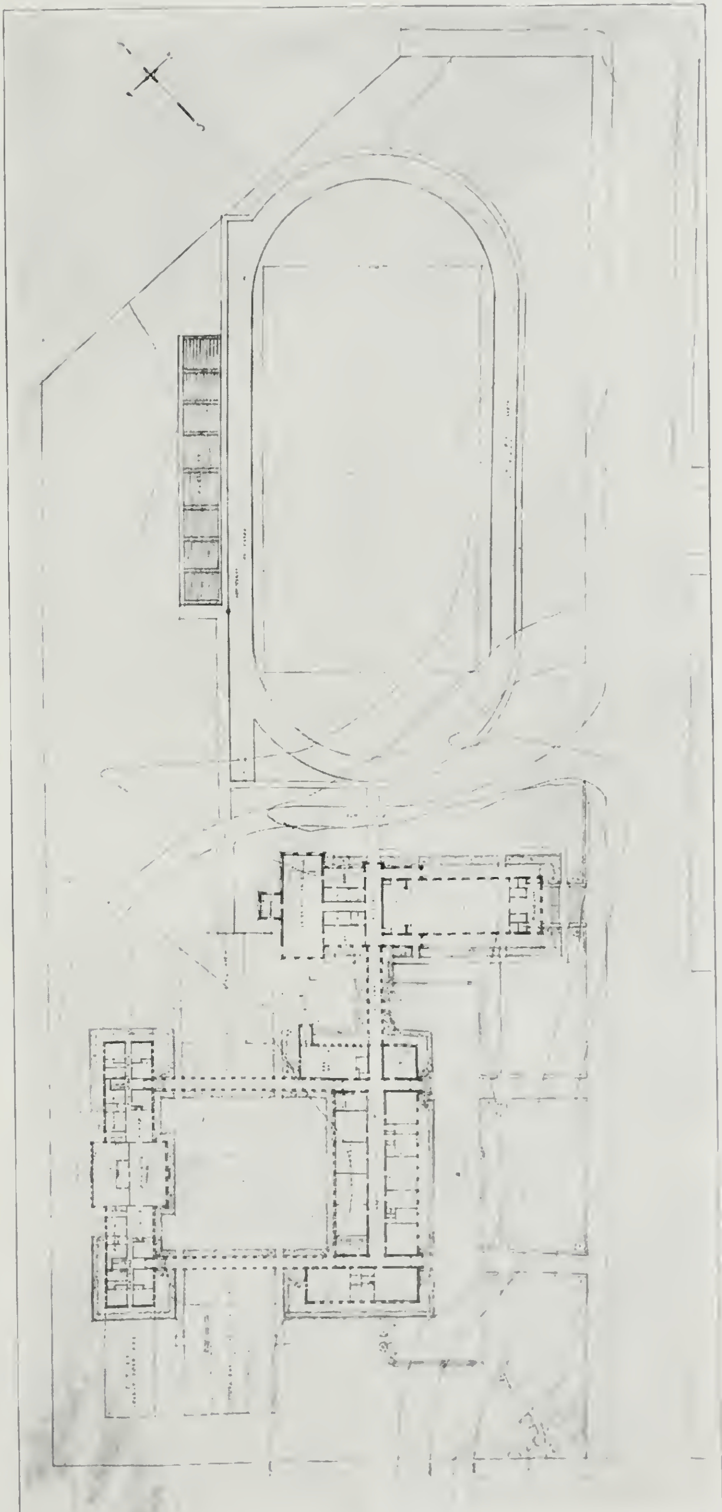
FIRST FLOOR PLAN, CLASSROOM BUILDING, ELKO COUNTY HIGH SCHOOL, ELKO, NEV

J. J. Donovan, Architect, Oakland, Cal.



BIRDSEYE PERSPECTIVE, ELKO COUNTY HIGH SCHOOL, ELKO, NEV.

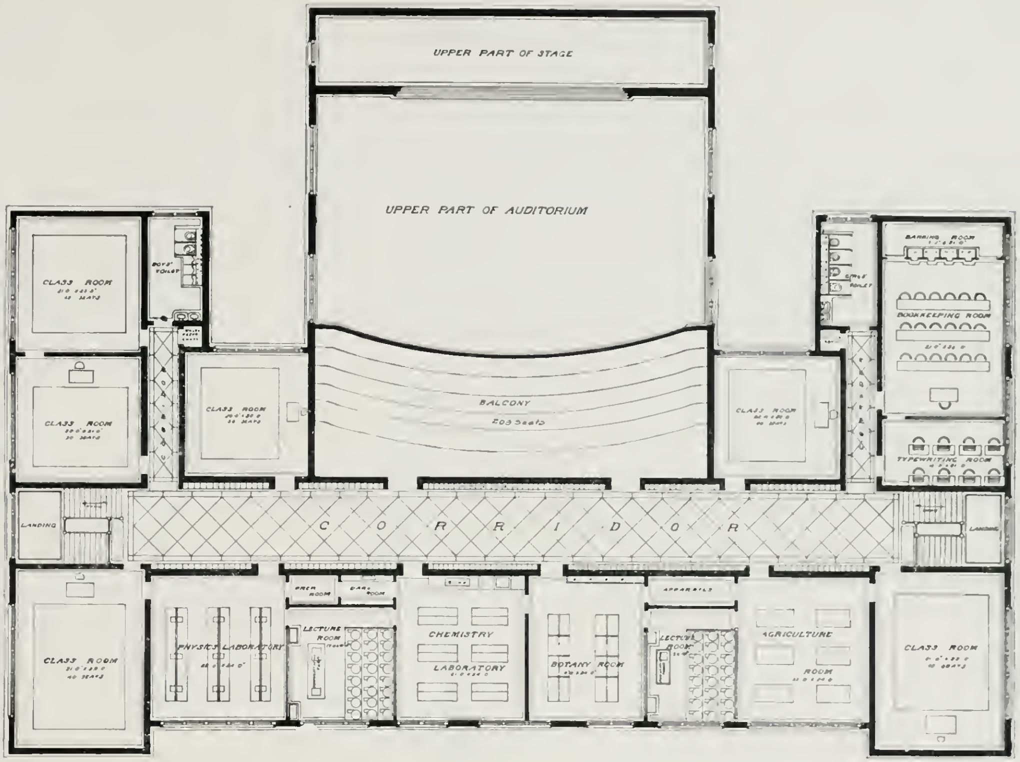
J. J. Donovan, Architect, Oakland, Cal.



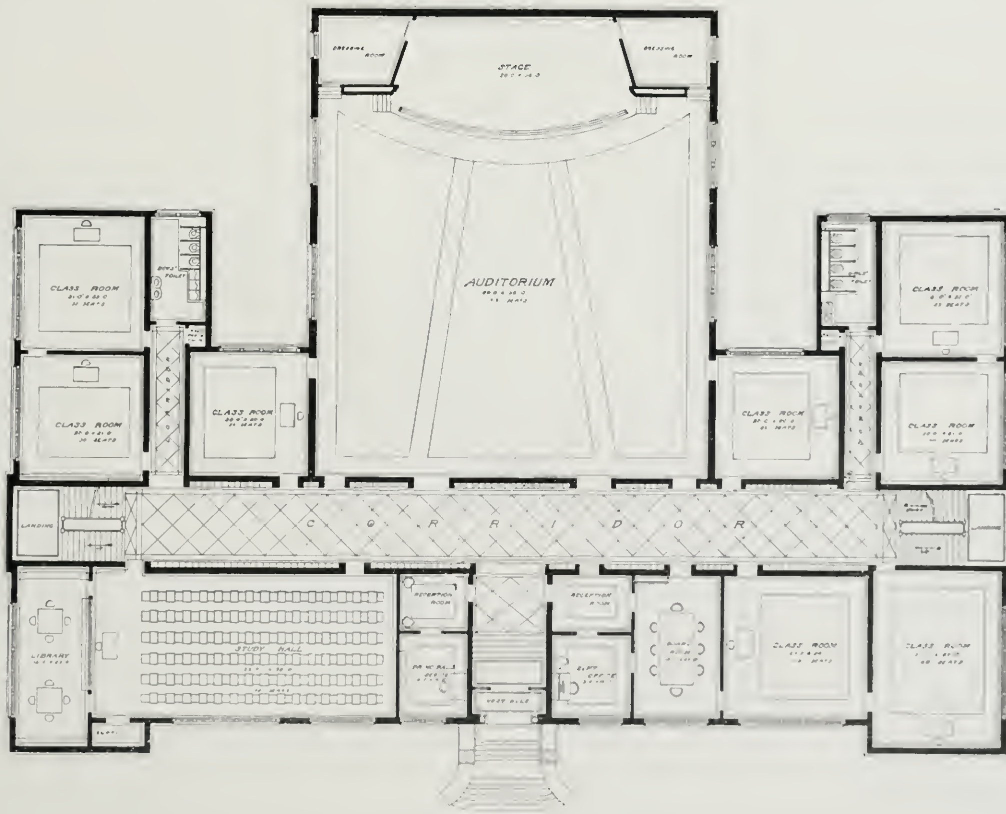
PLAT PLAN, ELKO COUNTY HIGH SCHOOL, ELKO, NEV.

J. J. Donovan, Architect, Oakland, Cal.

HIGH SCHOOL, IOLA, KANS.
Thomas W. Williamson & Co., Architects, Topeka, Kans.

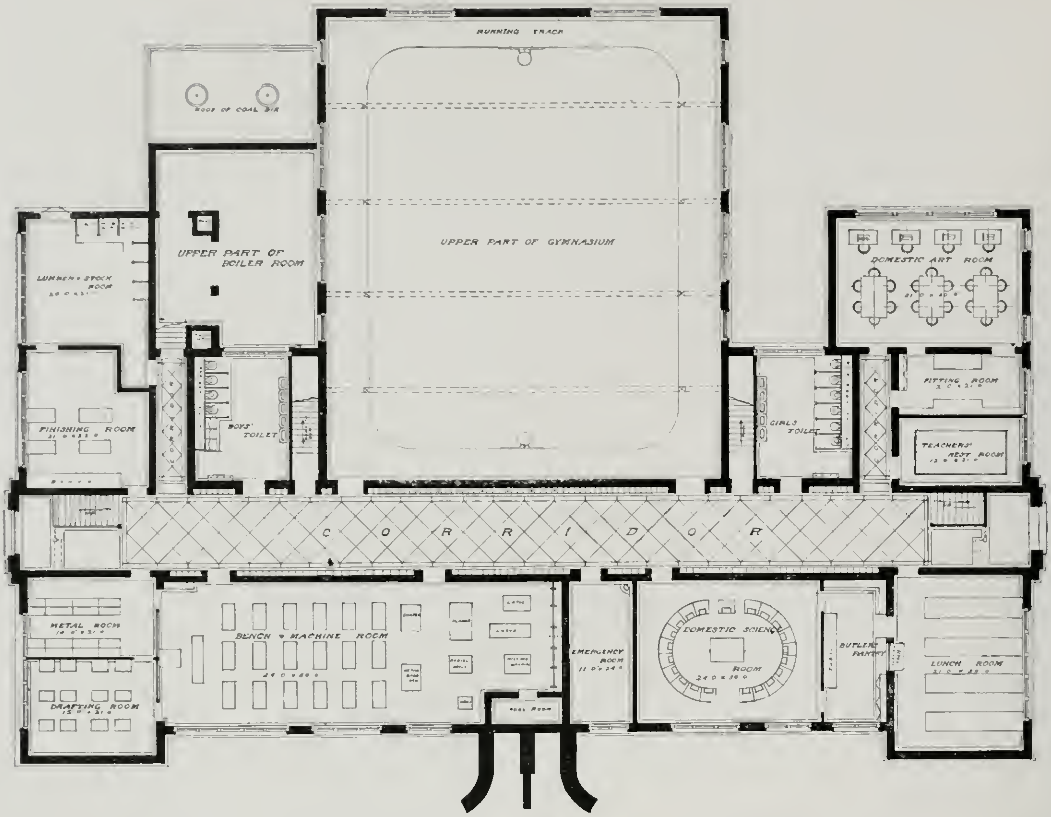


SECOND FLOOR PLAN

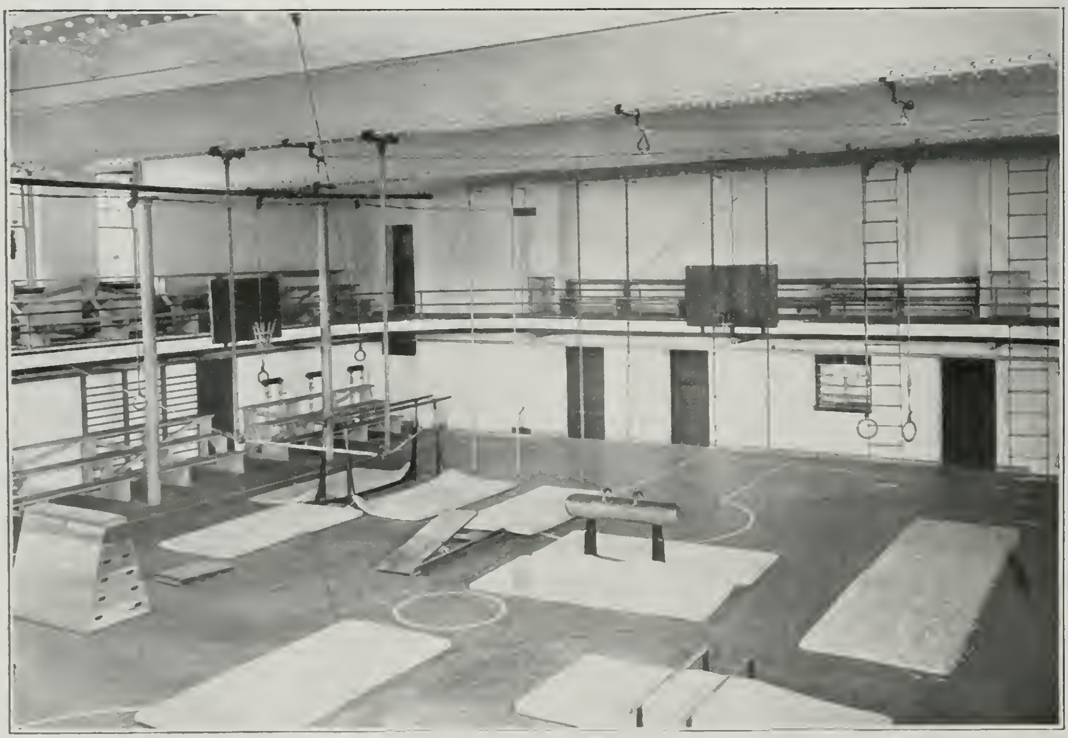


FIRST FLOOR PLA

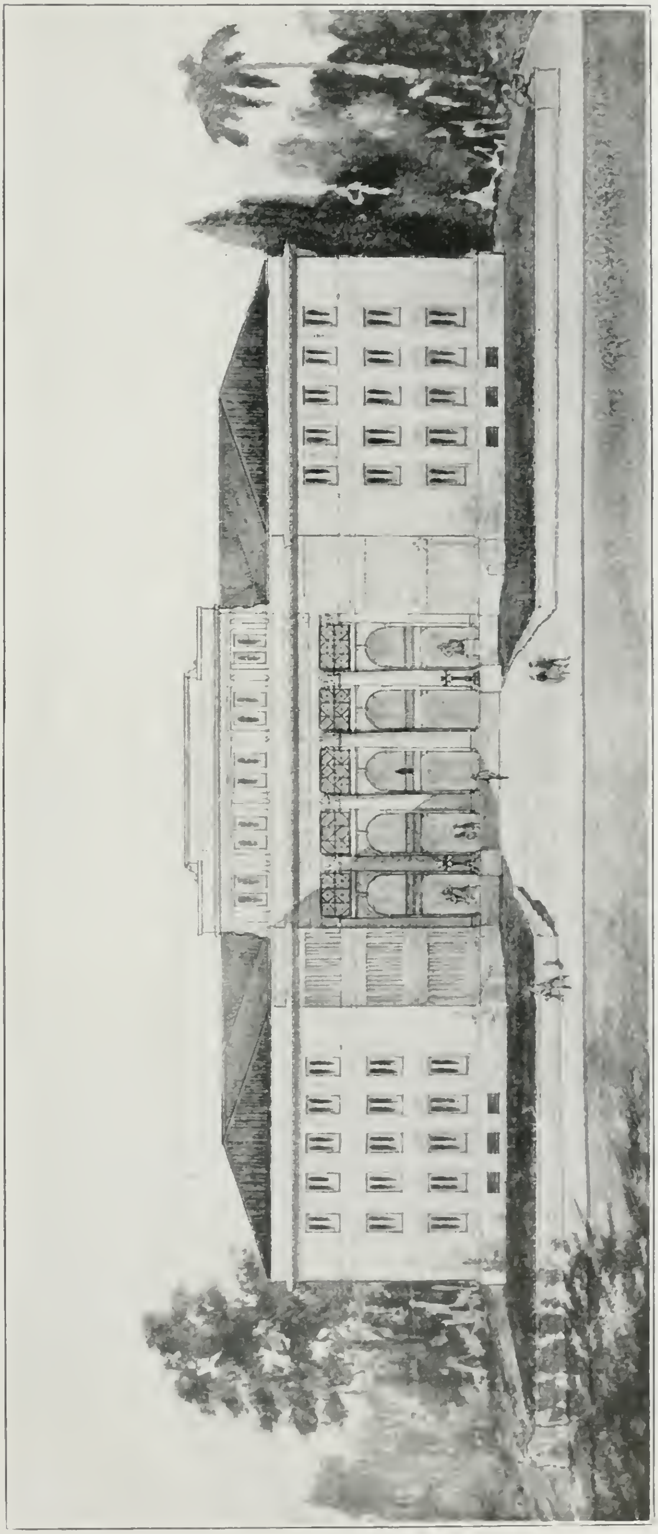
FLOOR PLANS, HIGH SCHOOL, IOLA, KANS.
Thomas W. Williamson & Co., Architects, Topeka, Kans.



GROUND FLOOR PLAN

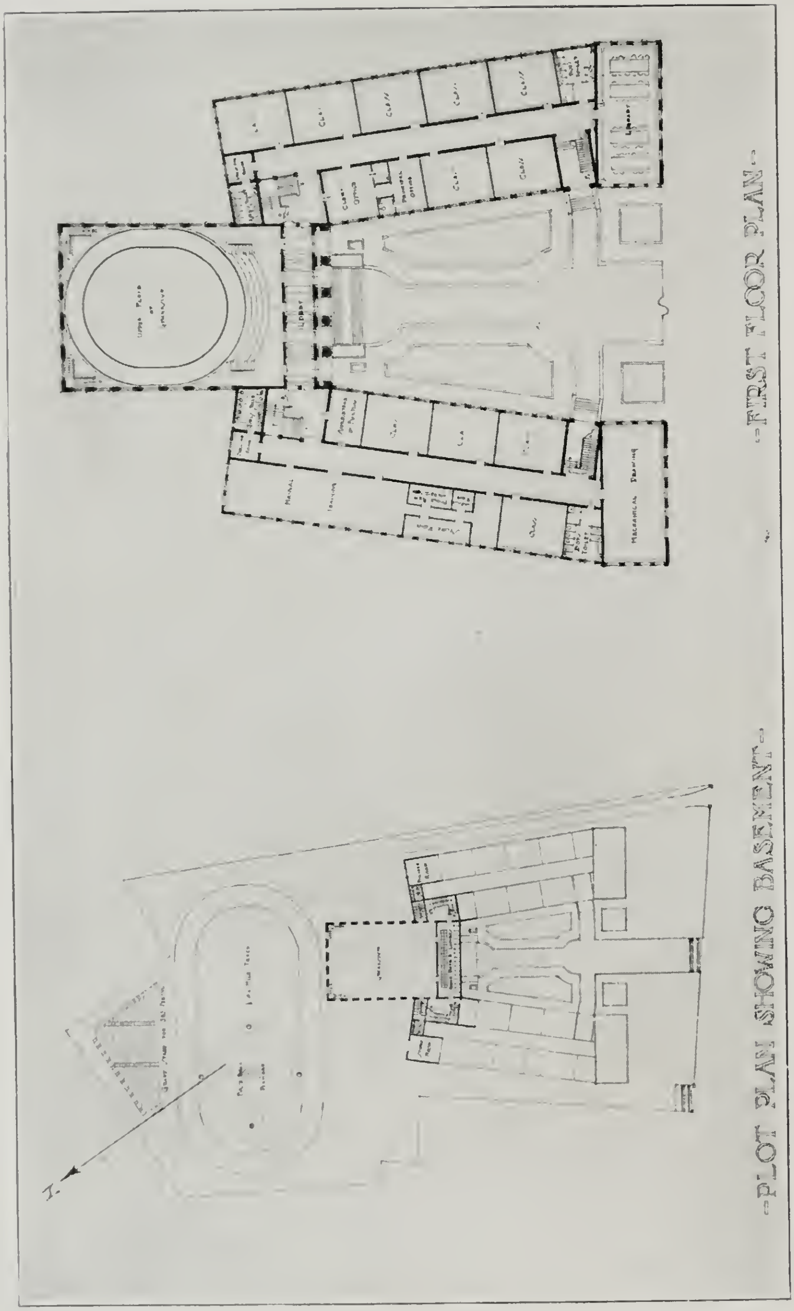


GROUND FLOOR PLAN AND GYMNASIUM, HIGH SCHOOL, IOLA, KANS.
Thomas W. Williamson & Co., Architects, Topeka, Kans.

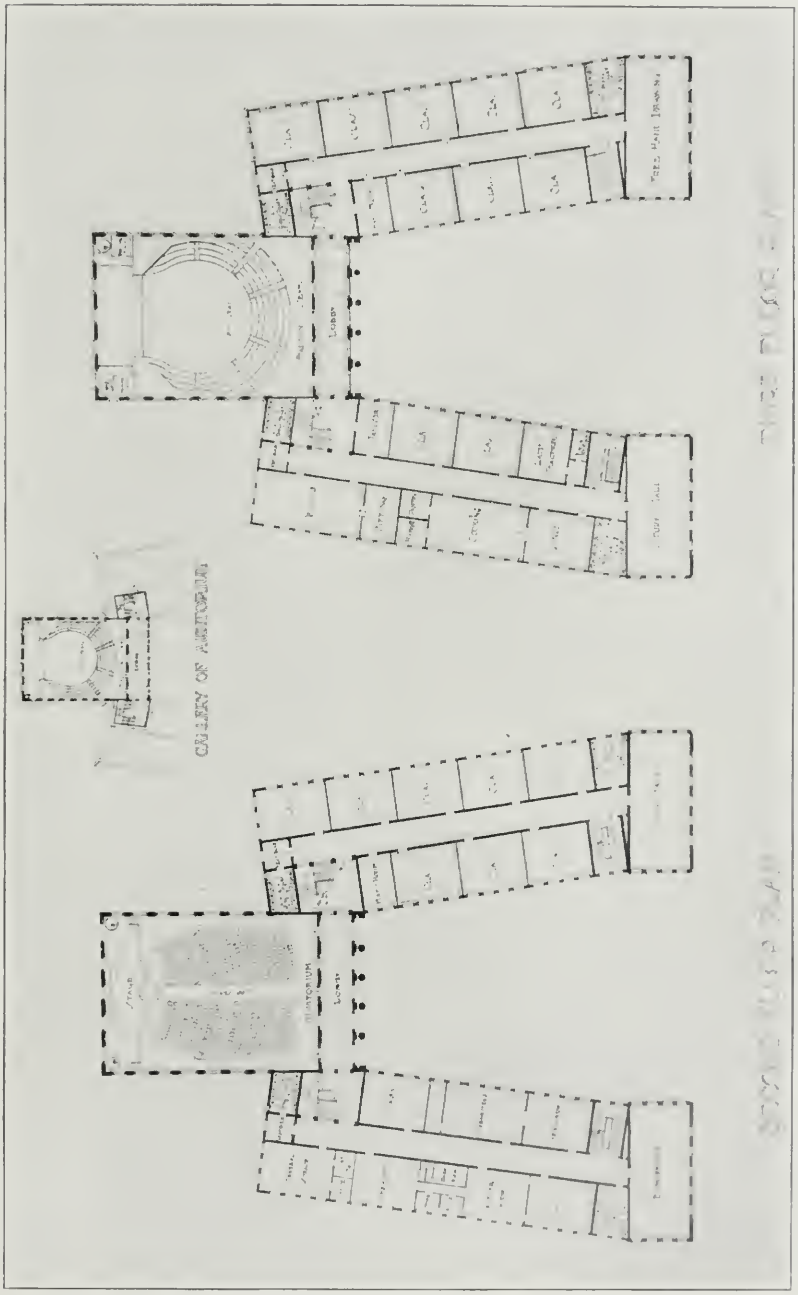


HIGH SCHOOL, SAN JUAN, PORTO RICO.

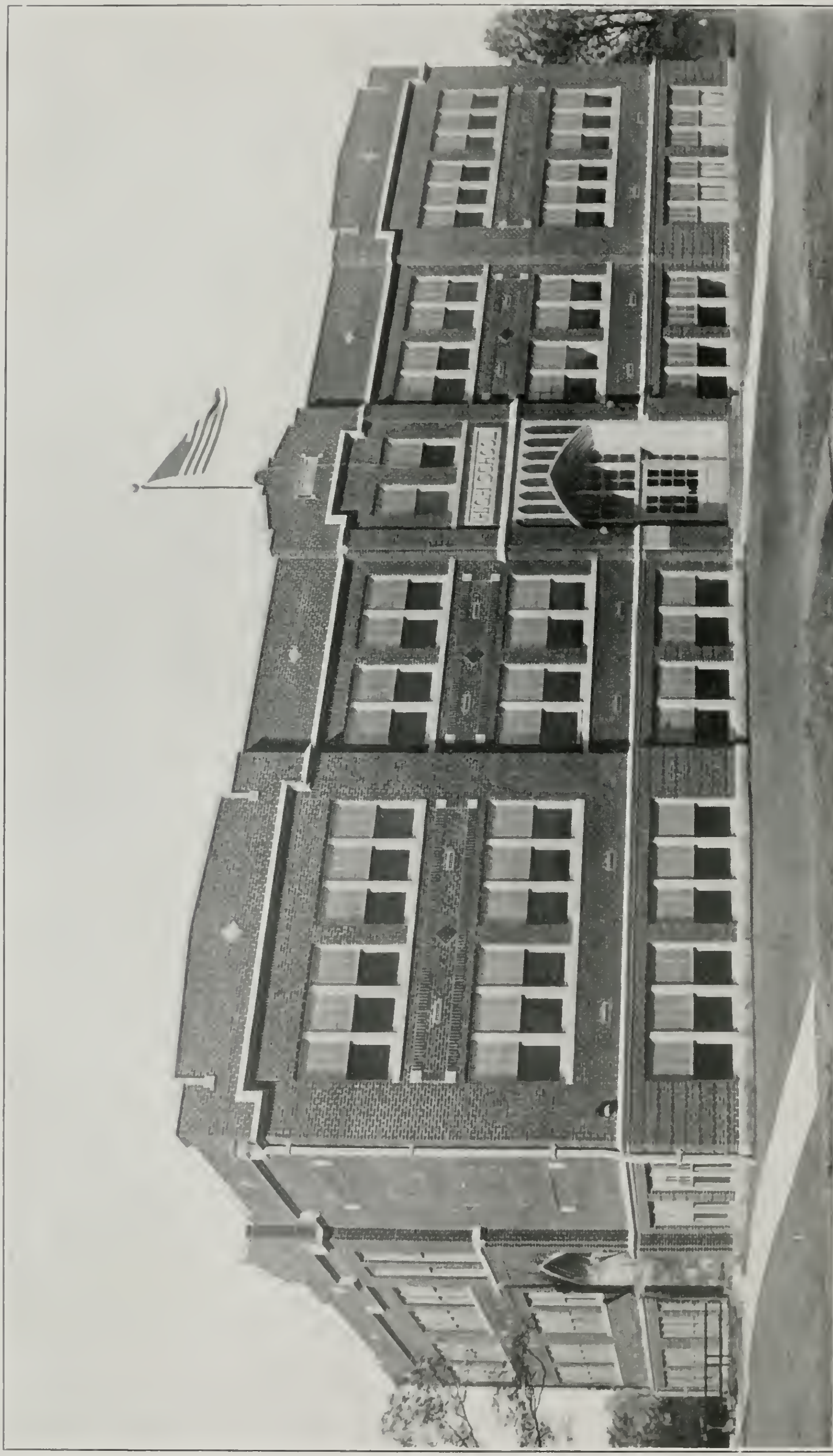
A. C. Finlayson, Architect, San Juan, Porto Rico.



HIGH SCHOOL, SAN JUAN, PORTO RICO.

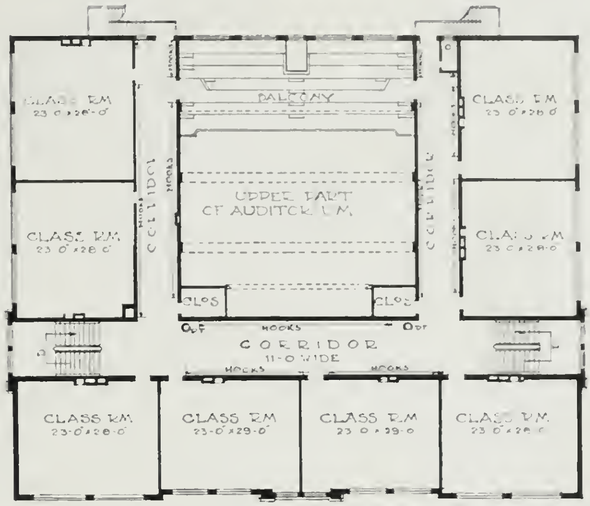


HIGH SCHOOL, SAN JUAN, PORTO RICO.

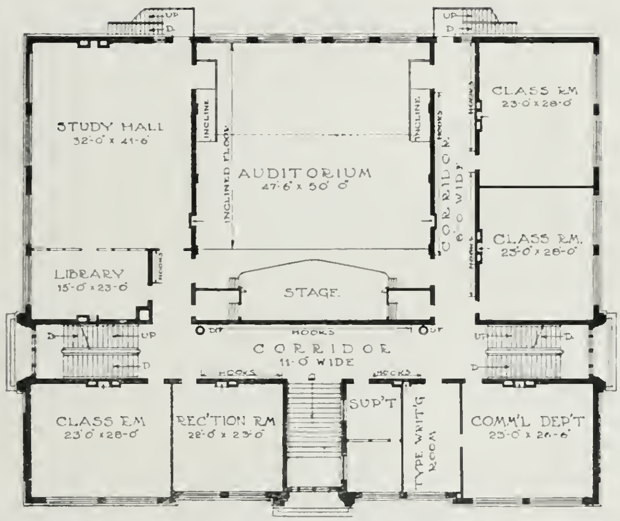


HIGH SCHOOL, CALDWELL, KANS.

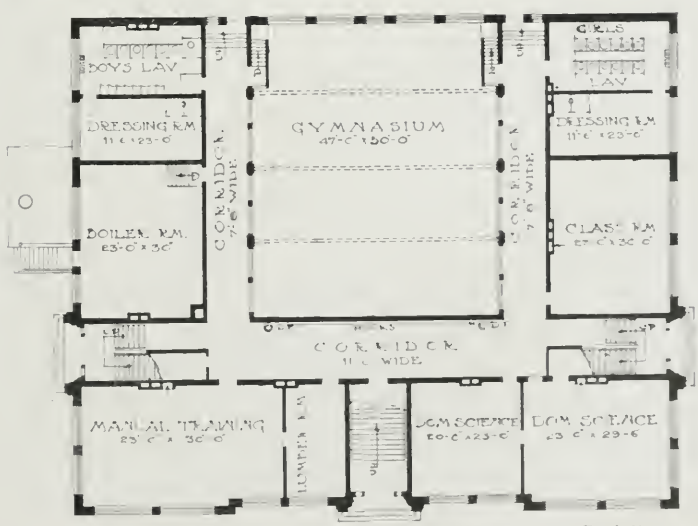
S. S. Voight, Architect, Wichita, Kans.



SECOND FLOOR PLAN

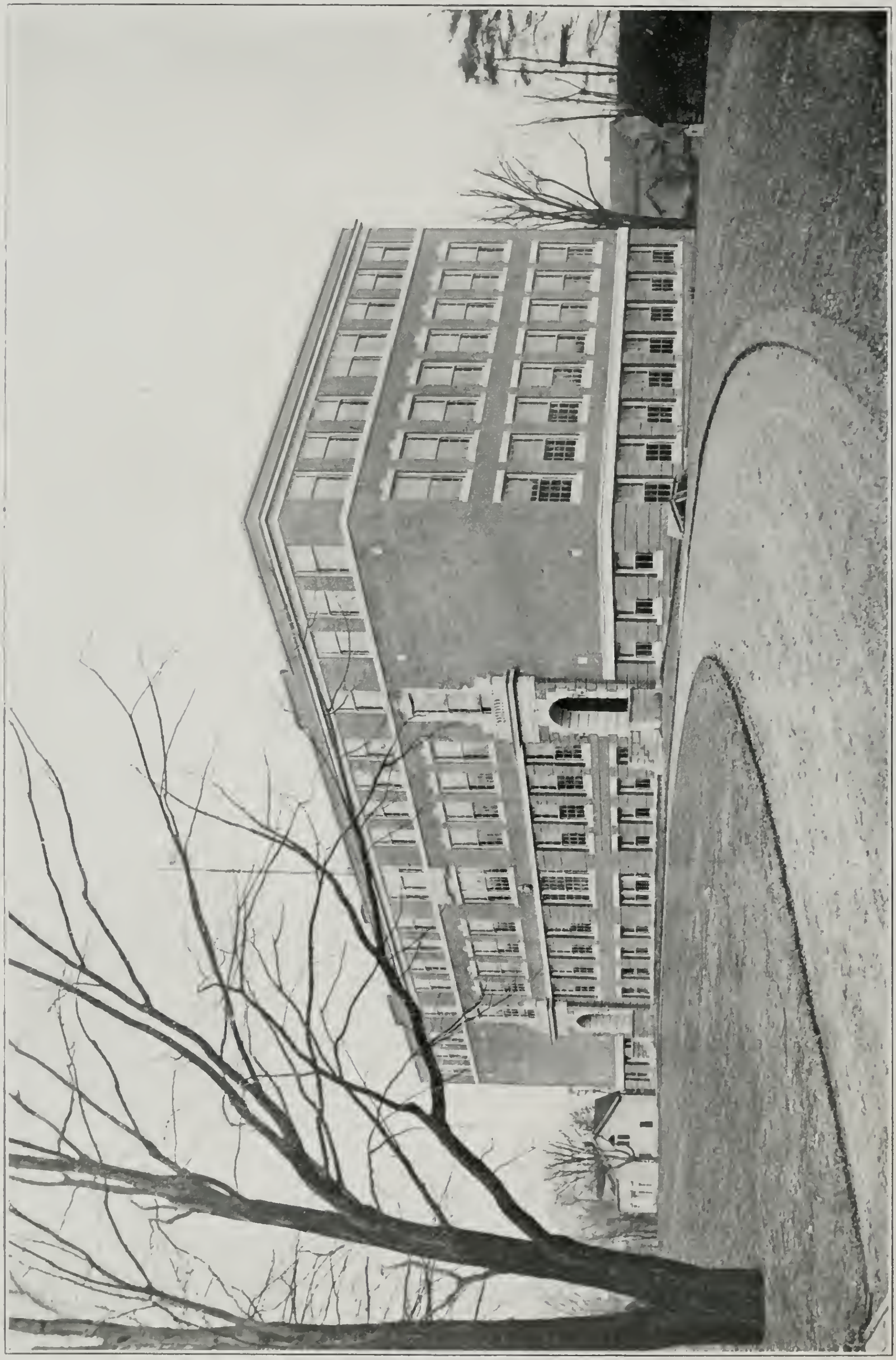


FIRST FLOOR PLAN

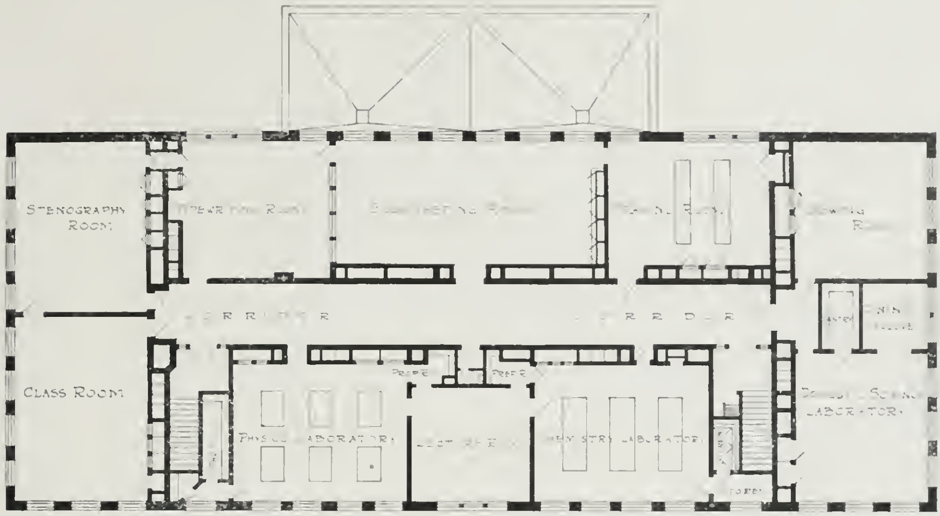


GROUND FLOOR PLAN

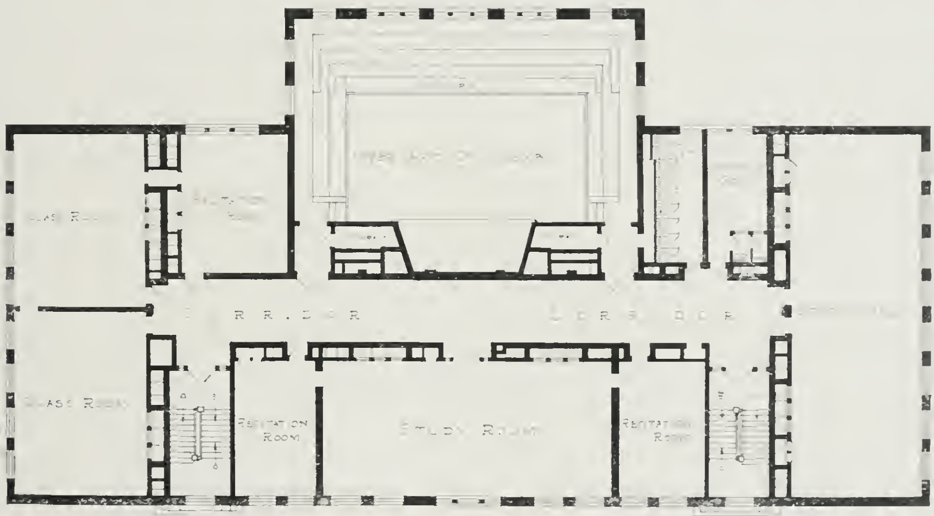
FLOOR PLANS, HIGH SCHOOL, CALDWELL, KAN.
S. S. Voight, Architect, Wichita, Kans.



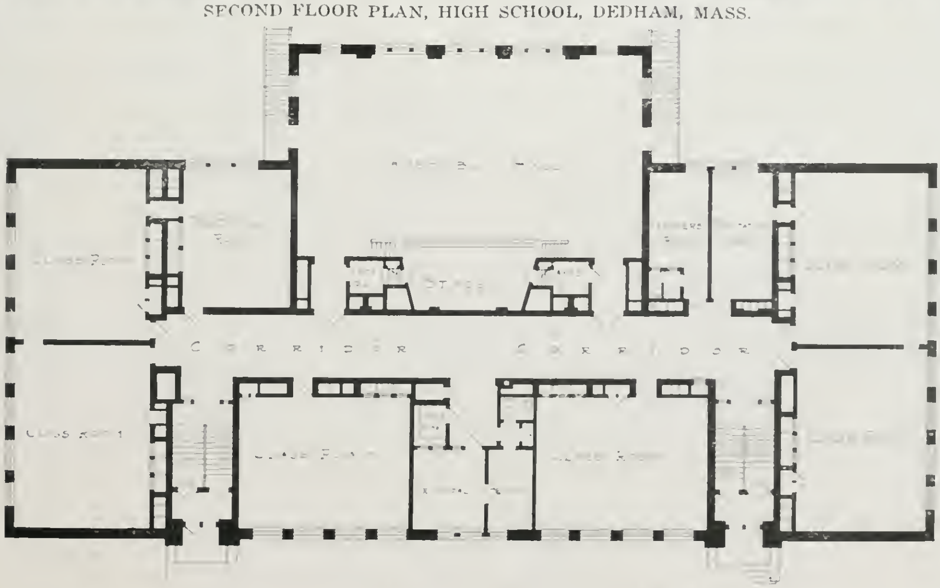
HIGH SCHOOL, DEDHAM, MASS.
Kilham & Hopkins, Architects, Boston, Mass.



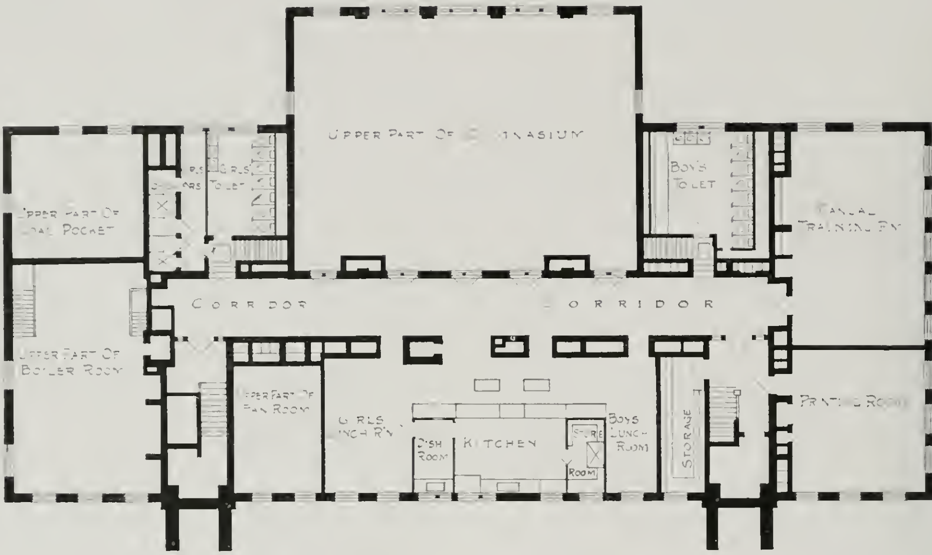
THIRD FLOOR PLAN, HIGH SCHOOL, DEDHAM, MASS.



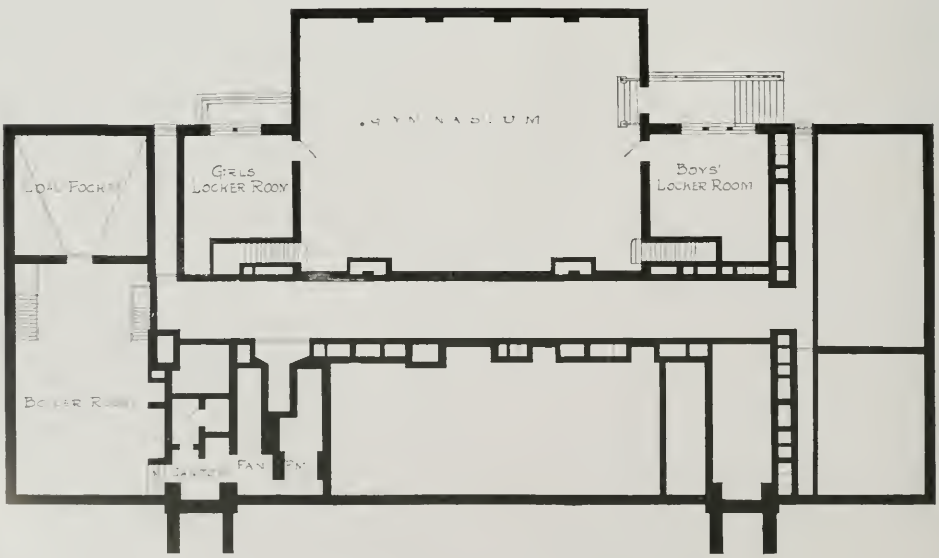
SECOND FLOOR PLAN, HIGH SCHOOL, DEDHAM, MASS.



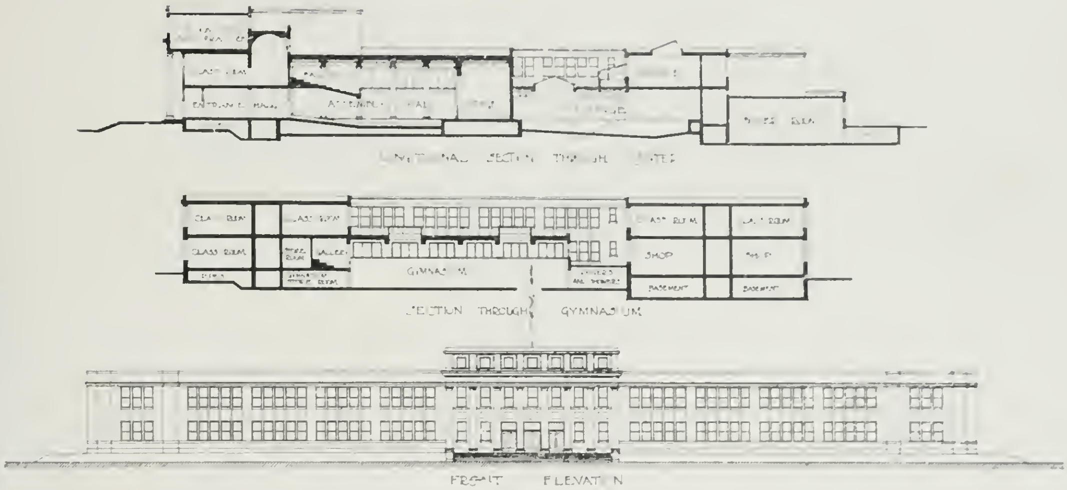
FIRST FLOOR PLAN, HIGH SCHOOL, DEDHAM, MASS.



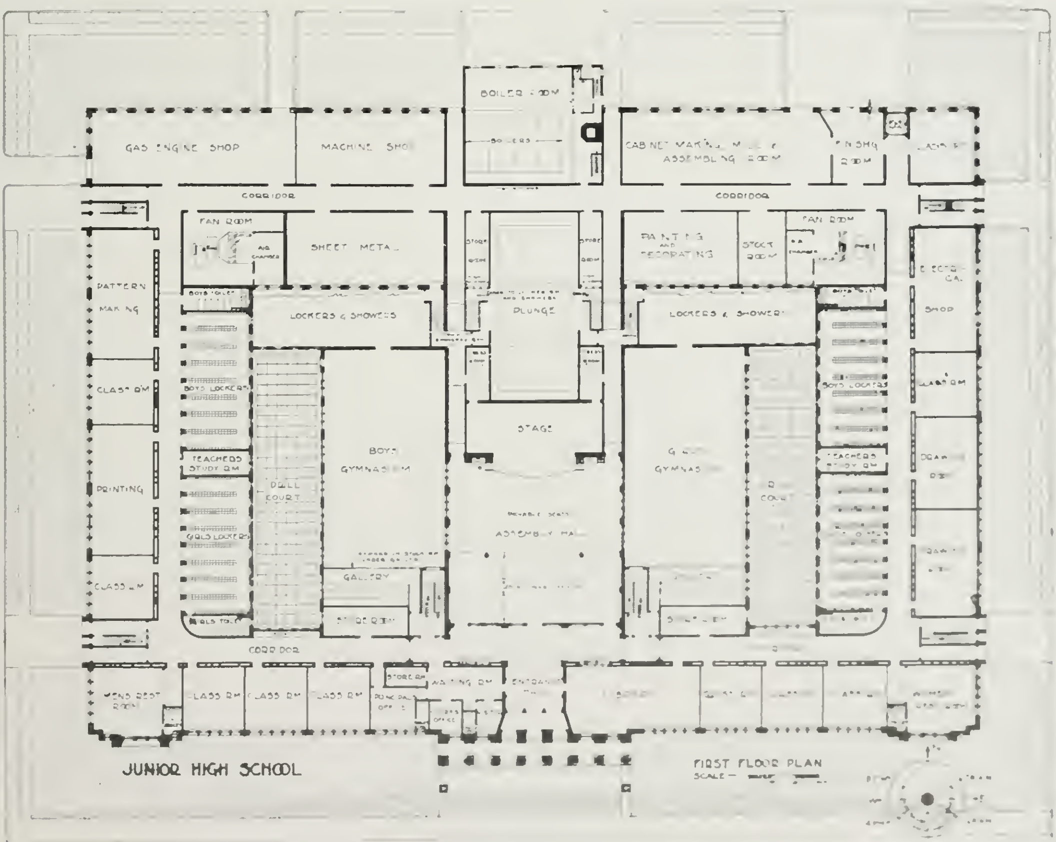
BASEMENT PLAN, HIGH SCHOOL, DEDHAM, MASS.



FOUNDATION PLAN, HIGH SCHOOL, DEDHAM, MASS.

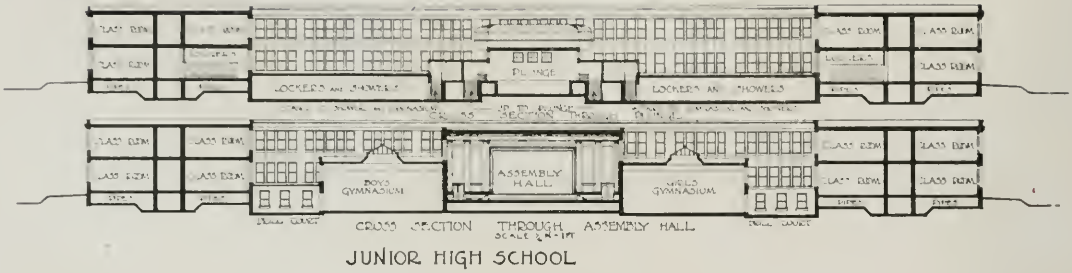


ELEVATIONS AND SECTIONS, JUNIOR HIGH SCHOOL, ROCHESTER, N. Y.

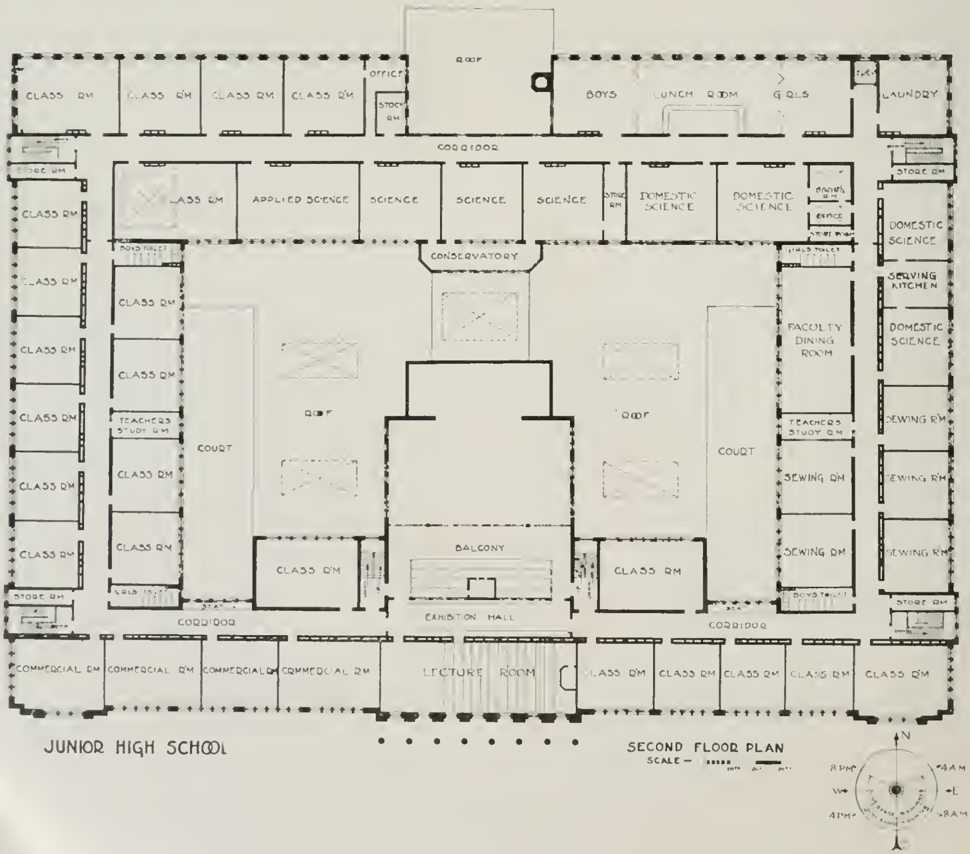


FIRST FLOOR PLAN, JUNIOR HIGH SCHOOL, ROCHESTER, N. Y.

Gordon & Madden, Architects, Rochester



CROSS SECTIONS, JUNIOR HIGH SCHOOL, ROCHESTER, N. Y.



SECOND FLOOR PLAN, JUNIOR HIGH SCHOOL, ROCHESTER, N. Y.

Gordon & Madden, Architects, Rochester.